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Electrical World

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THE publication of an engineering and industrial journal that succeeds in rendering the best possible service to its industry is a ceaseless effort to outdo its own record of achievement. The industry expands, the opportunity unfolds and the paper must serve more greatly with the greater need if it is to sustain its leadership.

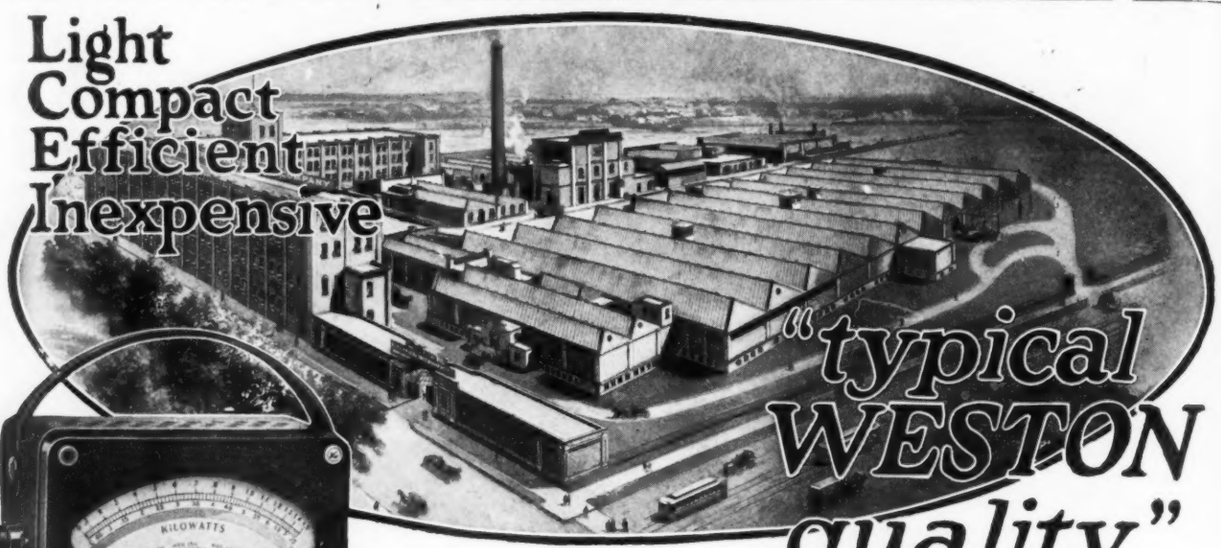
This issue of the ELECTRICAL WORLD tells the story of a year of unparalleled accomplishment in the electrical industry and pictures the vision of an even greater year to come. It is a wondrous story well told. The facts show that three milestones—the fifty billion kilowatt-hour mark in generation and distribution, the billion dollar mark in energy sales and the five billion dollar mark in capital invested—have been passed by the light and power branch of the industry.

It marks, I believe, a new advance in the quality of service which the ELECTRICAL WORLD has been rendering to electrical men now near onto fifty years. To commemorate this point in our progress we have withdrawn this cover-page from the market and will use it in the future as a sign post of electrical advance.

James H. McGraw
President

Annual Progress and Statistical Number

Light
Compact
Efficient
Inexpensive



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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

Published by McGraw-Hill Company, Inc.

W. H. ONKEN, JR. Editor

HAROLD V. BOZELL Editor

Volume 81 New York, Saturday, January 6, 1923 Number 1

A Year of Records

DURING 1922 the central-station branch of the industry passed three mileposts. First, the total amount of energy sold by the various generating and distributing companies passed the half-hundred billion mark, thereby realizing the prophecy made several years ago by the ELECTRICAL WORLD that this mark could be reached by 1923. Second, the gross income from the sale of energy passed the billion-dollar mark and the industry finds itself indisputably in a class with the other primary industries of the country the value of whose products is in excess of a thousand millions. Third, the capital invested now exceeds five billion dollars, placing the electric light and power business ahead of all the other branches of the electrical industry, with the possible exception of electric railways, the fifth among the primary industries of the country. If the capitalization of all the various branches of the electrical industry is combined, however, that industry stands second, being exceeded only by the steam railroads.

During December the calls for electrical energy, especially in the intensely industrial sections of the country, were so great that the distributing companies found themselves unable to furnish more. This was true despite the addition by the central stations of the country during 1922 of about 1,600,000 kw. in generator rating.

The manufacturing and distribution branch of the industry has broken no particular records. But its total volume of more than $920,000,000 of manufactured products is a wonderful accomplishment following the low level of 1921.

It has been a year of records. And another year of records must follow in 1923 if the installation of generating equipment, the continuing extension of distributing systems and the inevitable development of new utilizations of electric service are to keep pace with the present rate of evolution and progress.

Giuseppe Faccioli

An electrical engineer of the first rank, whose influence upon apparatus design and upon the national activities of the profession marks him as both specialist and leader.

TWENTY years ago a young Italian engineer named Faccioli came to this country with the idea of finding out at first hand what was going on here in electrical development. He had spent the first years of his career designing alternating-current machinery and was keenly interested in American practice. He obtained a position with the New York Edison Company and after acquiring valuable experience in the laboratories of that organization determined to study metropolitan transit work. The Interborough Rapid Transit Company offered the desired opportunity. In 1904 he became a designing engineer for the Crocker-Wheeler Company, intending to return to his native country in a few months. Instead, while working upon the design of a new induction alternator for William Stanley, he attracted the interest of that electrical pioneer by initiating a method of calculating results in advance for new generating equipment. Giuseppe Faccioli became Mr. Stanley's chief assistant, remaining permanently in America, and today, as chief electrical engineer of the Pittsfield works of the General Electric Company and vice-president of the American Institute of Electrical Engineers for District No. 1, he stands among the honored leaders of the profession.

In the year 1906 the Stanley works became a part of the General Electric organization, and in 1908 Mr. Faccioli was transferred to the engineering department of the Pittsfield works. Three years later he became assistant chief engineer of the transformer department and in 1914 was appointed to the post he now holds.

The possibilities of high-tension transmission were early foreseen by Mr. Faccioli. Beginning with pioneer work on the systems of the Central Colorado Power Company and on high-tension switching and line oscillations on the system of the Great Western Power Company, he has for twelve or fifteen years given much time to the more profound problems connected with the development of transmission and related apparatus, including high-tension transformers, lightning arresters and other protective equipment.

Mr. Faccioli has been an indefatigable worker in the A. I. E. E. After having served year after year upon some of its most important committees and four years on the board of directors as manager, he was last year elected a vice-president. He is the author of many papers upon engineering subjects.

Mr. Faccioli was born in Rome on April 7, 1877. He was graduated in 1899 with high honors from the Institute of Technology, Milan, as a mechanical and electrical engineer.

Editorial Comment

Electrical World, January 6, 1923

Volume 81 Number 1

Sound Progress During 1922

ANALYSIS of the available facts about the electrical industry indicate that the growth which it has experienced during the past year has been sound and healthy and that despite conditions in other industries it has probably never experienced a more prosperous year, all factors considered, or entered upon the activities of a new year with any greater opportunities or greater assurance of development. It is now seen that the slump of 1921 was nothing more than a slight hesitation in the constant march ahead. The electrical industry is still young, but its aggressive management, sound policies and courageous practice have shown results, and as a consequence it has attained an enviable position in the nation and the future outlook is so auspicious it is impossible to set limits or even lines of growth.

THE central-station branch of the industry, which is of course the real business core, has reason for great pride in its accomplishments during the past twelve months. It has issued nearly six hundred million dollars in securities for refunding, for extensions and for new construction at a cost of less than 6 per cent, and in addition, through customer ownership campaigns, it has placed one hundred and seventy-five millions of dollars' worth of junior securities in the hands of its patrons. Incidentally, the customer ownership plan is now definitely recognized as a great constructive agency for securing and maintaining good public relations—and it might be added for encouraging responsible management.

It has so often been stated that it is almost accepted as a rule that the kilowatt-hour consumption doubles every five years, and if the thought of doubling by 1928 the fifty-two billion kilowatt-hours of 1923 almost staggers the imagination, nevertheless there is nothing to indicate that this will not take place. It is impossible even to predict the effect of the utilization of this great quantity of electricity on every aspect of national welfare.

In order to anticipate, and even in many cases to try to meet, this growing demand for electricity the industry has been exceptionally active in the construction of new generating stations, transmission lines and distributing systems. During the year applications have been made for the development of about eighteen million primary hydraulic horsepower, and there is now under construction more than two and one-half million primary horsepower in hydraulic developments. This new construction involves a direct investment of approximately eight hundred millions of dollars, to which, however, to get a better view of the picture, must be added the cost of transmission lines and distribution systems so that the total investment will exceed two billion dollars. When utilization equipment is added to this the total reaches figures it is almost useless to try to estimate accurately.

The advance of the industry has demanded advances in operating practices and in engineering development quite as significant as its business growth. The use of higher voltages and further interconnection of systems have been outstanding movements. Two hundred and twenty thousand volts will soon become commonplace. Radio and carrier-current equipment has been adapted to intra-system and inter-system communications in the interest of continuity of service. There have been great strides in the development of circuit breakers and use of automatic equipment. Larger and better boilers have been produced; higher steam pressures have been utilized, and powdered fuel has gained a place as a much stronger factor in central-station operation. The engineer has to his credit these and other developments, all of which have made possible better, more economical and more reliable service.

Meanwhile research and invention have been stimulated, and both within and without the industry has the commercial research department—whether pure science or engineering—been accepted and even appreciated as a valuable manufacturing activity. Outstanding among the research accomplishments have been the improvements in the vacuum tube, the development of higher voltage equipment, the discovery of new methods for determining stresses in metals, the production of new and better materials and the development of larger and better illuminating units.

IN THE manufacturing and distribution branches of the industry no marked changes have been consummated, but there has been a general stock-taking as a result of which it is safe to predict that future developments will be along sounder co-operative lines. The increase in the volume of business has been satisfactory. More than nine hundred and twenty million dollars' worth of manufactured products were produced, which afforded to nearly every company at least a normal and a profitable business. Any effect of the industrial slump was largely offset by the increased movement of central-station equipment. The end of the year is reached with many factories running at full load and with prospects ahead for full production in all lines in the near future. The hectic commercial condition of the radio field with its sudden popularity has settled down during the year to a sound business activity with real possibilities for development. The number of types and uses of household and industrial appliances was substantially increased, thus adding to the volume of energy-using devices which make life more livable and increase the use of electricity.

IN ITS political and social aspects the year was distinguished by the defeat of the California amendment for state ownership of water-power projects as well as by similar decisions in Georgia and Wisconsin. There have been activities either to limit or to broaden, depending on local conditions, the jurisdiction of state regulatory commissions. The controversy over the dis-

position of Muscle Shoals was most effective in exciting public interest in the question of how best to develop the nation's power resources. The general result has been, however, that public sentiment was never more favorably disposed toward everything electrical and that the electrical industry stands as a popular leader in national development.

The Problems of 1923 Call for Creative and Constructive Ability

WHILE the industry should congratulate itself on past accomplishments and may bask somewhat in the sunshine of its apparent future, it is worth while at the beginning of the new year to point out some of the factors which restrict its rapid advancement. Not all that is mentioned here is new, but a gathering together of these elements should prove useful for summing up incentives for constructive thought and activity.

INABILITY to raise all the funds that can be profitably employed in the business is the greatest single deterrent. A solution of the tax-exempt security problem is needed and decisive action must eventually be taken. As has been previously pointed out, the tax-exempt security has introduced a problem on account of the graduated income tax; and while the elimination of the latter would restore former conditions in which the tax-exempt security was little questioned, nevertheless its existence has inspired a study of the situation which may indicate the better solution to be the elimination of this type of security rather than the graduated income tax. And, indeed, if we read social tendencies correctly, there is very little probability of the elimination of the latter. At present, with state and local securities aggregating more than ten billion dollars and increasing at the rate of more than one and one-half billions per year, and with more than twenty-three billions of federal issues of the same character, a serious political and financial condition exists which threatens the economic welfare of the nation. This condition is apparently bringing about a situation whereby earned incomes are taxed at a higher rate than capital incomes, the government is losing tax revenues, and finally there is a certain sidetracking of capital from investment in private enterprises.

ONE feature of the healthy growth of the electrical industry is the adequate, efficient and universal distribution of electrical utilization apparatus to secure maximum output for central stations, better service to the user and the most effective growth of the entire industry. In this task problems of manufacture and distribution are brought directly home to every one in the industry. There is real work to be done, for, as regards simplification of practices, advances in standardization, and the selection of the best channels and methods of distribution and marketing, it is recognized that an unsatisfactory if not chaotic state exists in many places.

WHILE technically the industry is well advanced and realizes most of its service possibilities, nevertheless in connection with cables, circuit breakers, transmission lines, insulators, motors and boilers there are still more problems to be solved in order that the industry may render its best service at greatest economy. The varied types of distribution systems, the uneasiness evidenced in trying to get away from needless expense in underground and station construction and the historic power systems with much uneconomical equipment brought about by the rapidly changing art, all point to engineering and economic questions which must be answered. Still other problems not yet outlined are brought about by the rapid extension of electrical service and the piling up of the consumption of electrical energy in congested districts.

DESPITE the California decision, state ownership of water powers is still an issue. Home rule and regulation has again become a political slogan in many sections. Muscle Shoals is still to be allotted and the effect of a final decision there will be far-reaching. In meeting these problems, which are largely those of public relations, the present advantageous position of the central stations must not be lost but rather capitalized.

THE commercial development task before the industry is, of course, to secure the greater use of electricity and electrical appliances in the home, eliminate the twenty-six million horsepower still privately generated and used in manufacturing establishments, and to secure the electrification of more railroads. Then again, in the marketing of electricity to the public in general the ever-present question of rates is met and there is more and more call for constructive and equitable—and easily interpretable—rate schedules. Another serious problem is that of extension of service into the rural districts, and this confronts every central station no matter what its size. The answer is being called for more and more insistently. This rural extension problem is a vexing combination of finance, public relations, utilization and engineering, and some solution must be found before embarrassing reactions occur.

MERELY listing these major problems indicates that they all affect more or less directly every activity of the electrical industry, and that no branch of the industry can afford to rest on its own laurels. Constructive work is required sufficient to keep every one in the industry busy. The tasks must be taken up with courage and vision and in a co-operative effort to secure results which will give correct and conclusive answers to the problems which are met.

The Central Station Outstrips the Private Plant

BACK in 1904, less than twenty years ago, more than 72 per cent of the motor load of the manufacturing establishments and the mines of the country was carried by private generating plants. Today the central generating plant carries about 60 per cent of this industrial load. Such is the story of the rise of the central station and the consequent downward trend of private generation of electrical energy. Data collected from thousands of industrial plants scattered throughout the country and presented elsewhere in this issue indicate, however, that there were still (in 1920) seven primary industries in which the major portion of the motor load was carried by private generating plants. The central-station industry has accomplished great tasks, but the industrial power field is still white for the harvest.

Advocates of more intensive standardization campaigns will find additional arguments for their program in the data on motor-operating voltages collected in

this survey. The reports from 6,904 companies indicate that there are at least fifty-seven different voltages in actual use in the operation of the motors in the factories and mines. Doubtless concession to circumstances accounts for most of the variations from the usual figures, but it is questionable whether justifiable cause exists for such wide departures from the voltages accepted by the profession as standard. The iron and steel industry is the most serious offender in this regard, which is undoubtedly due to the fact that this industry has the largest number of private generating plants, many of which have been in service for several years. However, much encouragement may be taken from the fact that as a rule only standard voltages were reported by companies which purchase from central stations.

Some of the Engineer's Pipe Dreams

NOW and then there comes even to the sanest of investigators a play of the imagination that encroaches on the realm of the magician. Often it is so specious that it bears its not unwilling victim away on the wings of prophecy, only to drop him into the hopeless morass of things that might be but are not. It is not easy to tell at a glance the phantoms of the fancy from the visions of the seer. Many never discover the difference, even if they desire to do so, and still more love the glamour of the improbable for itself and dwell perpetually on the borders of the unreal. Perhaps the best criterion of sound prescience is to subject the phantasm to the rigorous test of quantitative study. A great many things put on a brave front so far as qualitative tests go, only to disappear like a wisp of fog when the ruthless inquirer turns on the light of uncompromising figures.

Just recently a pair of technical sports, born of unbridled imagination, have attracted enough of public attention to demand investigation, and both being based on comprehensible theory, it is not difficult to bring them down to the region where weights and measures hold sway. One of these cheerful eidola is the production of "cold light." For years it has been with us, usually in the guise of the firefly's secret. Undeniably the insect does produce, by a chemical process which is beginning to be understood, a luminous effect at astoundingly high efficiency. But when one inquires how much, and whether the active substances can be obtained in quantity, one has to admit that the supply of light-bearing creatures is really not enough to furnish material for experimentation, and that there has not been the slightest hint of any possible synthesis, as in the case of most of the products of the physiological laboratory.

The latest aspect of the cold-light project is a study of substances sensitized by admixture of radio-active material as in the luminous dial of a wrist watch. An investigator has figured here a luminous efficiency of a very high order, unhappily linked with a brightness which is low even as compared with the firefly. And it therefore turns out not only that the light given is from a source inconveniently large for every-day purposes and obtainable only by the use of rare substances, but also that to replace this world's artificial light to any useful extent one would have to talk in tons instead of milligrams, aggregating more radioactive material than the imagination has yet touched as a possibility. It would be the case of the osmium lamp over again, but a thousand times worse. There is small hope of any illuminant under such a quantitative handicap, however alluring the efficiency. In fact, although numerous illuminants are known which are far more efficient than those ordinarily in use, all so far are attended by cost or inconvenience of a forbidding character.

Another recently revived chase of the will-o'-the-wisp has to do with electric heating for general use. In these days of sixteen-dollar coal and no cars to speak of the theory of heat from a wire at a quarter-million volts looks good until one coldly figures on conditions as they are. To start with, as a matter of sheer thermodynamics a big turbo-generator reckoned in thermal units at its busbars has barely the efficiency of a fireplace. And while we talk glibly sometimes of mouth-of-the-mine plants, there are in fact very few places in which coal can be delivered at the boiler room without as much labor and transportation as would suffice to load the same fuel for distance shipment. Water power looks a better bet, and yet to rely on it for heating in our climate would overrun the supply nature has provided. Any one who seriously figures out at current costs the price of station production, transmission and distribution for heating in a concrete case will quickly find that generalities do not audit bills and that we cannot thus escape the curse of an uncompromising climate.

The ELECTRICAL WORLD is a consolidation of the ELECTRICAL WORLD, the *Electrical Engineer* and the *American Electrician*, which was effected on Jan. 1, 1906.

The ELECTRICAL WORLD traces its history to the year 1874, at which time *The Operator*, entirely devoted to telegraphy, began its career. In 1883 the telegraph journal, which was a monthly, became *The Operator and Electrical World*, and on April 28 the paper was divided and the ELECTRICAL WORLD began its separate career.

In 1888 *The Electrician*, founded in 1882, became the *Electrical Engineer*, which remained a monthly until 1890, when its first weekly issue was witnessed.

In 1894 the ELECTRICAL WORLD adopted its present quarto style. The *Electric Railway Gazette* was absorbed in 1896, and in 1899 the ELECTRICAL WORLD and the *Electrical Engineer* were consolidated, the McGraw Publishing Company acquiring ownership and management. With this change came the adoption of the title ELECTRICAL WORLD AND ENGINEER, which the paper bore until 1906, when the *American Electrician*, a monthly founded in 1896 and owned by the McGraw Publishing Company, was absorbed. The paper has since been known as the ELECTRICAL WORLD.

Each of the editors of the various journals named contributed to the traditions and standing of the publication in the profession. C. O. Mailloux was in reality the first technical editor of the ELECTRICAL WORLD. Others who directed its editorial policy were Franklin I. Pope, Dr. Louis Bell, C. J. H. Woodbury, Joseph Wetzler, J. E. Woodbridge, Ralph W. Pope, N. S. Keith, H. W. Frye, G. H. Stockbridge, C. T. Rittenhouse, C. T. Child, C. P. Poole, T. C. Martin, W. D. Weaver, Frank F. Fowle, Dr. A. S. McAllister and F. M. Feiker.

The present staff of the ELECTRICAL WORLD consists of:

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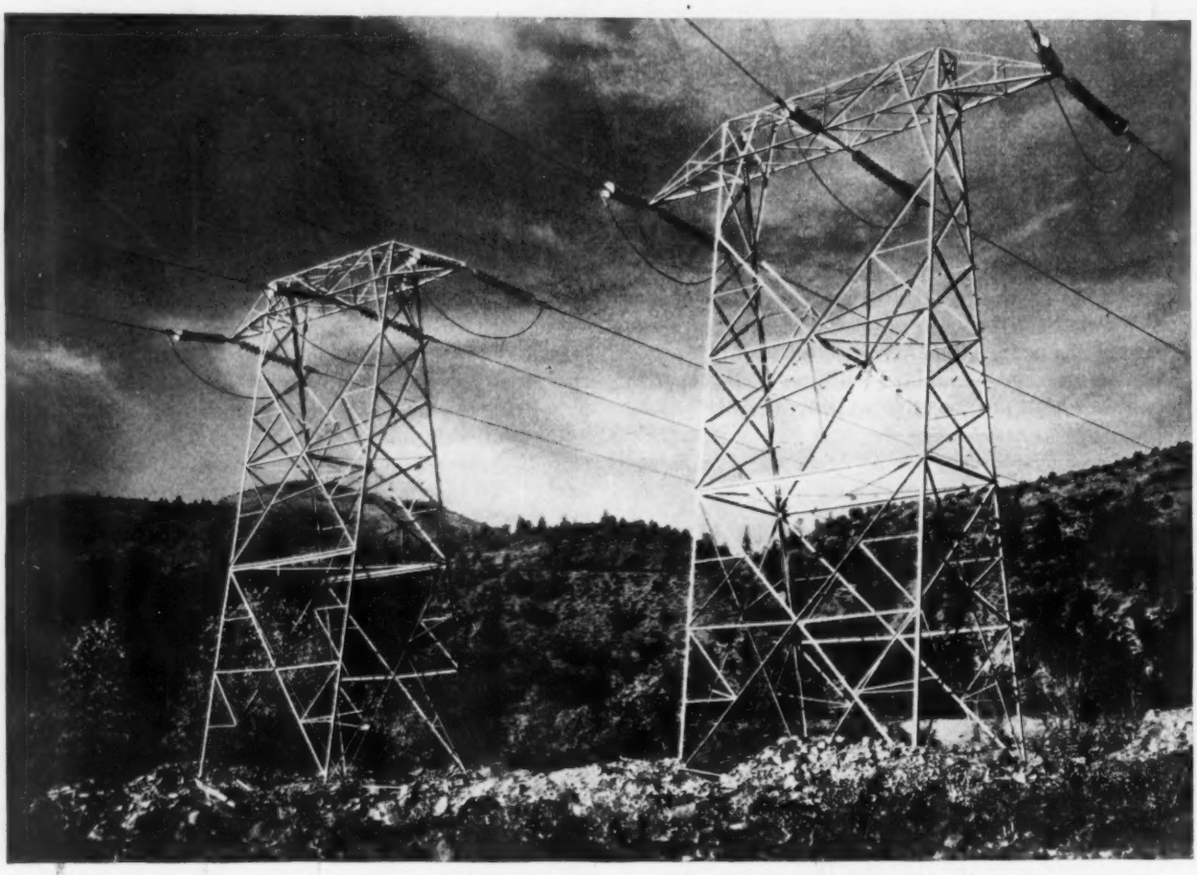
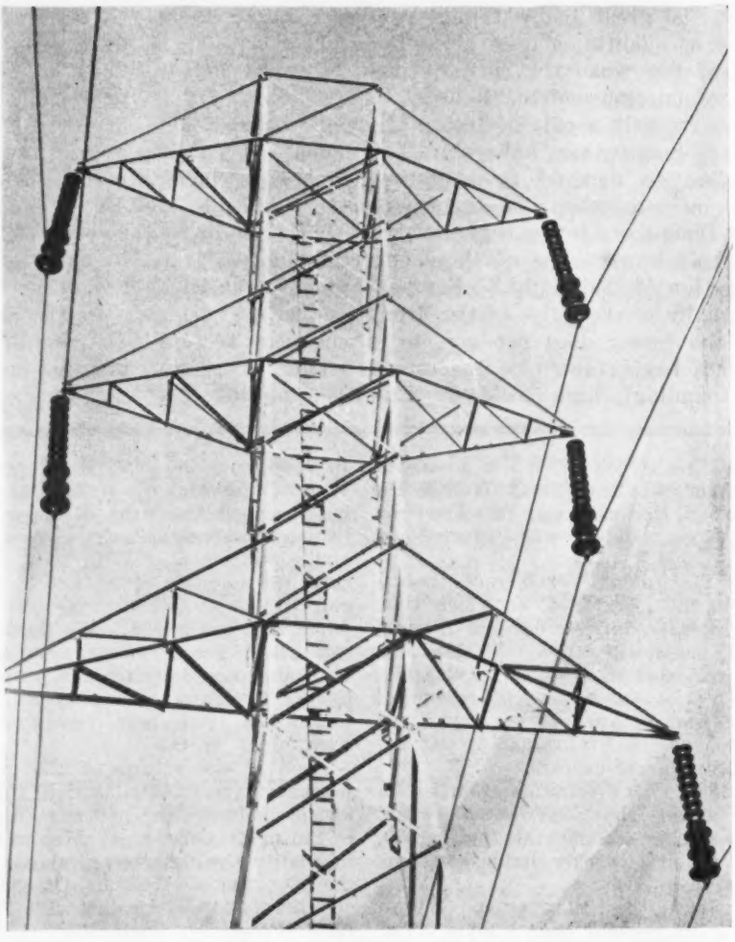


The New World's Record Transmission Line

THE new 220-kv. trunk lines of the Pacific Gas & Electric Company constitute a world's record in the transmission voltage employed. Power is being transmitted over the only one of these circuits yet completed from the Pit River Plant No. 1 in northern California to the Vaca substation in the lower Sacramento Valley, a distance of 202 miles. The specially designed conductors used are composed of seven strands of copper cable, each of which is in turn composed of seven strands of single wire. The cable has a cross-sectional area of 500,000 circ.mil and weighs 8,400 lb. per mile. Six of these cables, constituting two complete circuits, are strung on steel towers spaced seven to the mile, embedded in concrete foundations and having a height of from 60 ft. to 97 ft., the 60-ft. towers being a special type utilized in the snowy regions. These two circuits have a capacity of 235,000 hp. at 220 kv. In the construction of this transmission line 10,000,000 lb. of copper cable and 16,000,000 lb. of steel were utilized. The cost of the line, exclusive of substations, will be approximately $33,000 per mile. The copper was purchased in a single order, the largest ever placed. It required 107 cars to ship the cable, which was wound on 1,928 reels, with one-half mile of cable to the reel.

The upper view shows some snow towers with strain construction. The lower view shows the special insulator strings adopted, each consisting of ten standard disks, four special units and a copper-disk corona shield.



Recent and Prospective Developments of Underground Cable

By D. W. Roper
Superintendent of Street Department
Commonwealth Edison Company

Samples of Cable Have Been Made and Tested Successfully at 250 Kv.—Possibilities of Cables for 110-Kv. Operation Are Indicated—Some Points to Consider in Specifications

ABOUT 1900 two 25,000-volt underground cables, one paper-insulated and one rubber-insulated, were installed in St. Paul as part of a transmission line from a power house on the St. Croix River.* For about twenty years thereafter there was no material increase in the maximum operating potential of underground cables installed in this country. Recently some three-conductor, 33,000-volt cable has been placed in operation in Chicago, and the city of Los Angeles has ordered some three-conductor cable for operation at 35,000 volts. Another large company is now installing some single-conductor cable for operation at 44,000 volts between conductors, and still another company is investigating the feasibility of obtaining single-conductor cable for operation at 66,000 volts. These increases in the maximum operating voltage of underground cables have been made possible by the reduction in recent years of the dielectric loss in underground cables with impregnated paper insulation. Such losses have been reduced to so great an extent that they are now but a small fraction of the losses in the cables made five years ago, and it is possible to get cable in which the dielectric loss is so low that it does not seriously affect the carrying capacity of the cable. Several cable manufacturers have on regular commercial orders furnished cable having a dielectric power factor below 2 per cent at 80 deg. C., and the lowest record is below 1 per cent at that temperature. This means that when it is desired to increase the voltage the dielectric loss will not be the limiting feature.

*This installation was described in a paper presented by Henry Floy before the American Institute of Electrical Engineers on Nov. 23, 1900.

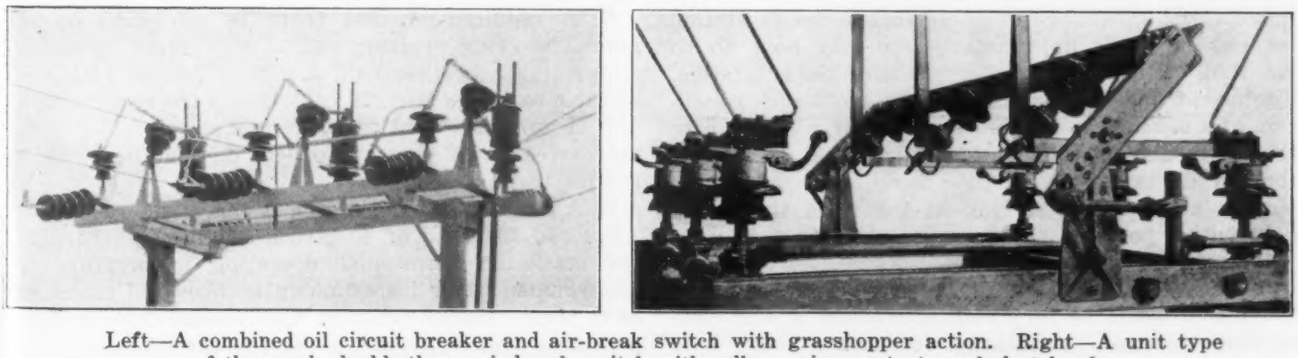
Some engineers have contended that the ionization loss at low temperatures would be a serious factor in the operation of high-voltage cables. One English manufacturer, however, advertises ozone-proof cables, and his published dielectric loss curves indicate that his cables are free from this trouble. If his claim is well founded and if past history can be used as our guide for predicting the future, we may safely assume that this one manufacturer will not long be the only one that can make cables free from ionization.

Possibility of Cable Operation at 110 Kv.

The cable manufacturers and operating engineers who co-operated in preparing the National Electric Light Association cable specifications agreed that the dielectric strength of a short sample of cable should be four times the normal working pressure. One manufacturer has already made a sample of single-conductor cable that withstood a test in excess of 250 kv. between conductor and lead, and the test was discontinued before the sample failed, as the voltage had reached the maximum range of the testing transformer. This would indicate that so far as dielectric strength alone is concerned this sample would have been suitable for operation at 63 kv., which corresponds to 109 kv. between conductors on a three-phase circuit.

The article by J. L. R. Hayden and Dr. Steinmetz in the ELECTRICAL WORLD of Oct. 21, 1922, page 865, describes some experiments from which they conclude that dielectric failures were due to a pyro-electric effect. If this is the case, then with the reduction in the dielectric loss there should be a reduction in the heating which causes the failure, and it seems possible that

Many Improvements Made in Outdoor Switches



Left—A combined oil circuit breaker and air-break switch with grasshopper action. Right—A unit type of three-pole double-throw air-break switch with roller arcing contacts and sleet hoods

with the very low-loss insulation that the cable manufacturers are now able to furnish we should be able to operate cables at a somewhat higher stress than heretofore without increasing the chances of failure of the insulation. This may mean that a lower ratio than four between the dielectric strength and the operating voltage is entirely feasible.

From the evidence at hand it appears that one sample of cable has been made with sufficiently high dielectric strength for operation as a single-conductor cable on a 110-kv., three-phase circuit. Other samples of cable have been made with a very low dielectric power factor, and still other samples have been made free from ionization. If it were possible to combine in one piece of cable all of the good features in the several samples of cable heretofore manufactured, then it would be entirely possible to secure single-conductor cable for operation at 110-kv., three-phase.

Although it is sometimes possible to locate a substation for reducing the line voltage from 110 kv. to some lower figure and have this substation act as a distributing station as well, it frequently happens that with the rapid growth of the city and the extension of its limits this high-voltage overhead line to the substation becomes seriously objectionable and may have to be removed. This would call for relocating the substation. The use of underground cable would avoid such relocation of a substation, and in some cases it will eliminate the entire cost of a substation which must be built at the city limits for the purpose merely of reducing the voltage and without serving at the same time as a distributing point.

Points to Be Considered in Specifications

While it would be very rash to attempt at this time to write an exact specification for such a cable, it is suggested that it will probably be found desirable to include in the specifications the following features:

1. Careful and thorough testing and inspection of the raw materials as they are received at the cable factory. This may mean taking a sample of paper from each roll and a sample of oil from each container and carrying a sufficient minimum stock of these materials to make it possible to reject defective lots without interfering with production.

2. Thorough inspection and supervision during the process of applying the paper insulation to insure that the workmanship is 100 per cent perfect.

3. Recording instruments and records in connection with the drying and impregnating of the insulation so as to insure that a careless or inefficient workman has not reduced the time required for these processes in order to cover up unnecessary delays or inefficiency on his part.

4. A requirement that an examination of the insulation, after the standard bending test, shall disclose no torn paper.

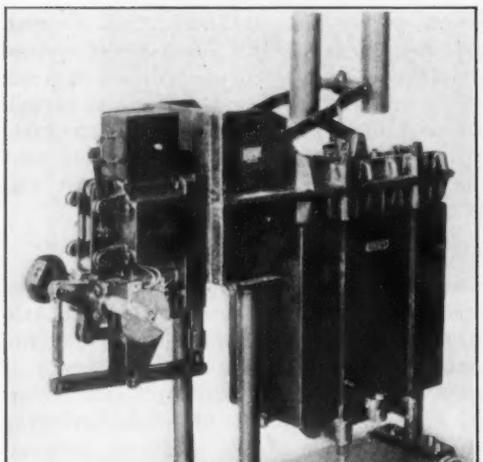
5. A routine test on each reel to insure thoroughness of impregnation.

6. A requirement that there be no ionization at normal working pressure and at the lowest operating temperature, together with a routine test on each reel of cable to insure that the cable meets the requirement.

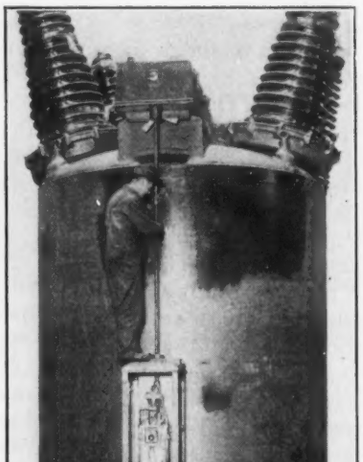
7. A guarantee that the dielectric power factor shall not exceed 2 per cent at 80 deg. C., together with a routine test on each reel.

8. A modification of the rule in the Standards of the American Institute of Electrical Engineers regarding the maximum permissible operating temperature of impregnated paper insulation in lead-covered cables so as to permit the operation of high-voltage cable at temperatures materially above the present limits.

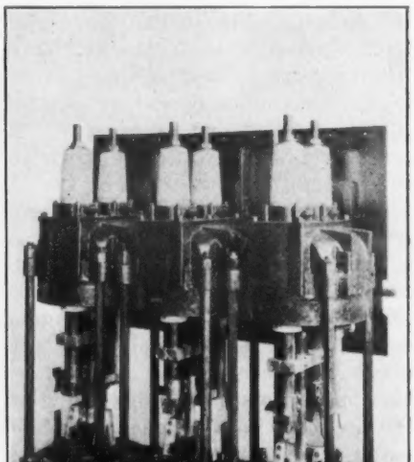
Circuit Breakers Made More Rugged and for Higher Voltages



Left—Unit type of oil breaker with provisions for connecting adjacent units by a universal coupling.



Center — Solenoid mechanism for operating a 220,000-volt oil breaker. A new type for heavy duty service.

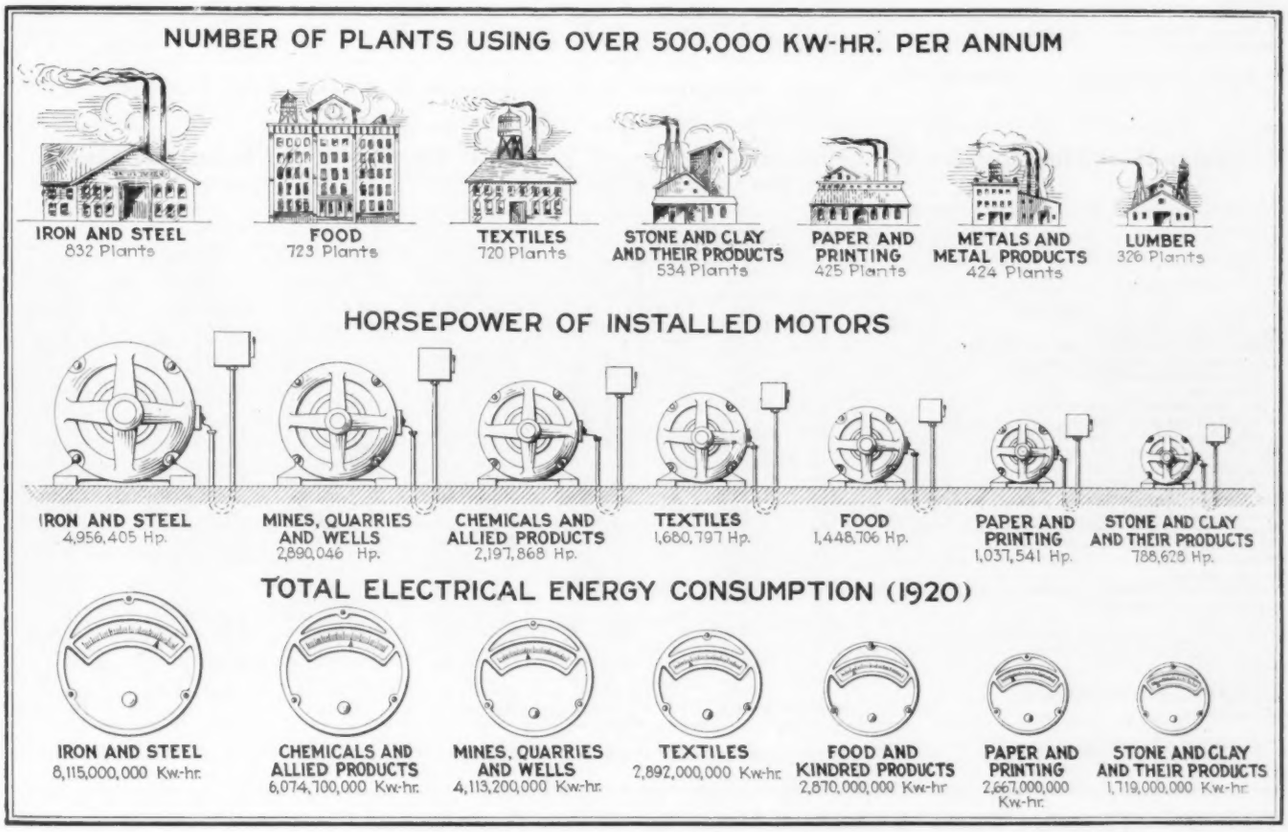


Right—Rugged construction, the use of inverted brushes and four breaks per pole are features of this breaker.

Industrial Load of the United States

By Robert M. Davis
Statistical Editor ELECTRICAL WORLD

Central Stations Generate 57.2 per Cent of the Energy Used in the Industrial Plants and Mines of the Country—More than Fifty Motor-Operating Voltages Are in Use in the Entire Nation



THE IRON AND STEEL INDUSTRY LEADS ALL OTHER INDUSTRIES IN THE USE OF ELECTRICAL ENERGY

THE industrial leadership of the United States of America is made most apparent through the study of a summary of its manufacturing and mining industries. No single country or federation of states can present such an array of economic industrial figures, almost too great for comprehension.

Data gathered by the United States Census Bureau indicate that on Jan. 1, 1920, there were 312,102 manufacturing establishments and mining concerns operating in this country, of which 256,071 reported an installation of prime movers totaling 25,280,699 hp. These industries in the aggregate represent an invested capital of $51,796,717,267, or more than double the present debt of the United States. The value of manufactured and mined products totaled $65,576,542,739 during 1919, or approximately one-half the total net cost of the four years' war in so far as the Allies and associated powers are concerned. These industries support 11,628,295 employees at an annual wage of $13,423,971,834.

Such is the potential manufacturing and mining power field of the electric light and power industry. It is probable that no other primary industry in this country affords such a vast and lucrative field for future development. The extent to which the central station has entered into the industrial life of the United States is clearly defined from a three-year nation-wide survey which has just been completed by the ELECTRICAL WORLD This survey was undertaken with the idea of ascertaining the extent to which electrical energy was being used by the industrial plants of the country and involved the sending out of about 95,000 questionnaires to the larger establishments.

The returns received from the survey have been divided into twenty-seven general industries, as indicated in the accompanying tables. The data are for the year 1920. Reports were received from approximately 20,000 companies, of which 15,000 rendered complete or fairly complete data on the use of electrical energy in their respective plants. Reports from only a part of the

Table I—General Economic Data on the Manufacturing and Mining Industries of the United States

(Taken from U. S. Census of Manufactures for 1919)

Industry	No. of Establishments in U. S.	Capital	Rent of Power and Cost of Fuel	Value of Products	Employees: Salaried (Number)	Employees: Wage Earners (Number)	Fuel Used: Anthracite Coal (Long Tons)	Fuel Used: Bituminous Coal (Short Tons)
Agricultural implements	521	$366,962,052	$5,038,512	$304,961,265	12,488	54,368	13,497	549,557
Chemicals and allied products	15,132	7,649,330,879	527,425,809	8,541,535,212	209,338	778,525	4,969,958	93,699,545
Electrical equipment and machinery	1,404	857,855,496	13,739,110	997,968,119	59,065	212,374	175,800	1,091,704
Food and kindred products	64,297	4,938,904,356	143,263,853	12,473,383,522	173,899	716,950	1,949,596	15,648,552
Iron and steel and their products	18,229	9,113,106,993	507,460,870	9,823,520,388	247,384	1,724,598	1,585,137	36,409,807
Leather and its products	5,901	1,539,413,929	18,280,885	2,572,885,556	42,479	344,477	169,746	1,992,811
Liquors and beverages	6,354	781,571,615	15,712,617	603,895,215	14,523	55,442	414,790	2,072,748
Lumber and its products	39,560	2,608,791,263	24,823,032	3,082,114,124	76,294	857,713	153,404	3,435,845
Metals and metal products other than iron or steel	13,851	2,225,496,508	43,969,854	2,932,005,502	88,346	528,251	543,006	3,467,425
Mines, quarries and wells	21,997	7,108,623,496	123,509,588	3,158,463,966	97,612	987,184	8,697,367	16,339,839
Paper and printing	37,141	2,487,379,347	75,248,650	3,113,778,179	174,152	527,165	1,167,595	8,878,207
Railroad shop construction and repairs	2,474	1,138,858,163	39,164,041	1,911,110,901	40,534	570,927	678,341	7,911,952
Stone and clay and their products	12,513	1,070,948,750	89,700,265	819,213,546	27,945	226,686	592,724	15,854,900
Textiles	30,511	6,273,635,504	95,039,084	9,378,547,167	150,251	1,627,277	1,782,183	8,490,495
Tobacco	10,291	604,839,572	2,321,085	1,012,933,213	15,679	157,097	4[illegible],716	281,288
Vehicles for land transportation	21,035	2,059,574,555	27,617,069	3,500,567,173	65,040	440,430	98,765	2,112,591
Miscellaneous	10,891	971,424,789	17,181,820	1,349,659,691	49,610	274,092	204,042	1,555,297
Totals for all manufacturing industries, mines, quarries and wells of U. S.	312,102	$51,796,717,267	$1,769,496,144	$65,576,542,739	1,544,639	10,083,556	23,240,667	219,792,563

Table II—"Electrical World" Estimate of the Use of Electrical Energy by the Industrial Plants of the U. S. in 1920 and 1921

Industry	Electric Generators (In Private Plants): Direct-Current No.	Direct-Current Total Rating, Kw.	Alternating-Current No.	Alternating-Current Total Rating, Kw.	Electrical Energy Consumed: Purchased from Public Utilities 1920, Kw.-Hr.	Generated in Private Plants 1920, Kw.-Hr.	Total Energy Consumed 1920, Kw.-Hr.	Total Energy Consumed 1921, Kw.-Hr.
Agricultural implements	82	16,600	26	20,480	78,500,000	85,900,000	164,400,000	74,600,000
Chemicals and allied products (total)	2,707	328,020	994	623,130	3,425,200,000	2,6 9,500,000	6,074,700,000	3,222,200,000
Rubber and rubber products	91	14,200	98	82,300	340,000,000	284,700,000	624,700,000	457,300,000
Glass and glass products	302	50,800	106	38,700	151,700,000	198,000,000	349,700,000	231,900,000
Chemicals	966	103,200	331	207,200	1,264,000,000	895,000,000	2,159,000,000	1,253,000,000
Smelting and refining of metals	160	32,500	52	40,100	260,800,000	168,000,000	428,800,000	98,000,000
Artificial gas manufacture	80	8,520	27	17,030	111,700,000	73,800,000	185,500,000	185,000,000
Miscellaneous chemical industries	1,108	118,800	380	237,800	1,297,000,000	1,030,000,000	2,327,000,000	997,000,000
Electrical equipment and machinery	113	24,930	53	167,000	298,000,000	308,000,000	606,000,000	530,200,000
Food and kindred products	1,222	134,200	546	169,800	2,023,000,000	847,000,000	2,870,000,000	2,798,500,000
Iron and steel and their products	4,040	818,000	1,295	1,008,000	3,890,000,000	4,225,000,000	8,115,000,000	3,685,000,000
Leather and its products	253	22,550	79	71,000	201,000,000	167,500,000	368,500,000	239,500,000
Lumber and its products	667	42,600	523	111,600	396,000,000	276,300,000	672,300,000	810,000,000
Metals and metal products other than iron or steel	302	42,100	189	72,000	816,500,000	336,000,000	1,152,500,000	495,000,000
Bituminous and anthracite coal mining	1,960	314,500	298	234,500	1,228,000,000	1,231,000,000	2,459,000,000	1,903,000,000
Metal mining	602	96,300	91	71,600	700,000,000	376,800,000	1,076,800,000	465,000,000
Stone quarries	64	10,640	22	8,160	331,400,000	41,800,000	373,200,000	281,000,000
Miscellaneous mines and quarries	103	16,080	16	12,270	38,700,000	64,400,000	103,100,000	67,200,000
Petroleum and natural gas	62	9,920	9	7,380	62,300,000	38,800,000	101,100,000	95,000,000
Paper and printing	470	72,600	360	264,200	1,603,000,000	1,064,000,000	2,667,000,000	1,967,000,000
Railroad-shop construction and repairs	743	54,900	451	184,700	481,000,000	597,000,000	1,078,000,000	900,000,000
Stone and clay and their products	748	126,000	262	95,500	1,228,000,000	491,000,000	1,719,000,000	1,295,000,000
Textiles	1,418	120,100	1,168	648,000	1,652,000,000	1,240,000,000	2,892,000,000	2,740,000,000
Tobacco	60	7,980	22	3,840	19,400,000	18,200,000	37,600,000	36,500,000
Vehicles for land transportation	81	12,600	53	28,000	353,000,000	93,500,000	446,500,000	364,000,000
Miscellaneous	298	39,800	102	19,130	215,000,000	90,500,000	305,500,000	230,000,000
Totals for all manufacturing industries, mines, quarries and wells of U. S.	15,995	2,310,420	6,559	3,820,290	19,040,000,000	14,242,200,000	33,282,200,000	22,198,700,000

Table III—"Electrical World" Estimate of Motors Installed in the Industrial Plants and Mines of the U. S.

Industry	Motors Run by Purchased Energy: Number	Motors Run by Purchased Energy: Total Rating, Hp.	Motors Run by Energy Generated in Private Plants: Number	Motors Run by Energy Generated in Private Plants: Total Rating, Hp.	Total Motors in All Plants: Number	Total Motors in All Plants: Total Rating, Hp.	Distribution of Drives: Motors Under 5 Hp.	Belt, Number	Chain, Number	Directly Connected, Number
Agricultural implements	4,594	47,842	3,399	52,421	7,993	100,263	2,012	3,632	241	4,120
Chemicals and allied products (total)	73,019	1,235,704	60,827	962,164	133,846	2,197,868	40,500	78,576	8,120	47,150
Rubber and rubber products	9,711	194,018	7,355	162,608	17,066	356,626	.....	.....	.....	.....
Glass and glass products	8,378	69,714	6,395	90,713	14,773	160,427	.....	.....	.....	.....
Chemicals	27,597	377,523	20,306	267,315	47,903	644,838	.....	.....	.....	.....
Smelting and refining of metals	5,058	173,495	4,787	111,768	9,845	285,263	.....	.....	.....	.....
Artificial gas manufacture	1,413	33,363	1,822	22,040	3,235	55,403	.....	.....	.....	.....
Miscellaneous chemical industries	20,862	387,591	20,162	307,720	41,024	695,311	.....	.....	.....	.....
Electrical equipment and machinery	42,023	235,605	38,472	243,761	80,495	479,366	46,400	47,931	764	31,800
Food and kindred products	118,234	1,056,146	37,589	392,560	155,823	1,448,706	68,500	93,493	20,330	42,000
Iron and steel and their products	166,794	2,376,931	124,199	2,579,474	290,993	4,956,405	73,230	131,993	8,800	150,200
Leather and its products	23,057	144,635	11,505	120,355	34,562	264,990	13,880	31,298	1,754	1,510
Lumber and its products	45,878	462,777	23,079	323,186	68,957	785,963	25,400	50,449	2,678	15,830
Liquors and beverages	14,420	87,718	11,164	85,898	25,584	173,616	11,230	15,344	3,340	6,900
Metals and metal products other than iron or steel	56,991	543,574	21,016	223,485	78,007	767,059	40,490	55,680	3,887	18,440
Bituminous and anthracite coal mines	23,088	889,539	24,849	893,214	47,937	1,782,753	16,640	12,712	1,825	33,400
Metal mines	11,274	507,461	5,599	273,241	16,873	780,702	5,850	4,501	642	11,730
Stone quarries	3,971	156,810	490	19,210	4,461	176,020	1,548	1,228	170	3,063
Miscellaneous mines and quarries	932	30,636	771	46,635	1,703	77,271	591	454	65	1,184
Petroleum and natural gas	1,849	45,134	1,330	28,166	3,179	73,300	1,103	848	121	2,210
Paper and printing	160,151	623,706	27,768	413,835	187,919	1,037,541	95,600	150,879	8,040	29,000
Railroad-shop construction and repairs	19,187	325,313	25,558	404,349	44,745	729,662	5,615	13,020	1,790	29,935
Stone and clay and their products	21,440	563,263	7,947	225,365	29,387	788,628	9,420	16,817	3,720	8,850
Textiles	157,760	959,845	69,019	720,952	226,779	1,680,797	136,800	100,609	18,170	108,000
Tobacco	3,382	14,430	1,842	13,447	5,224	27,877	3,532	4,543	114	567
Vehicles for land transportation	61,408	475,853	14,199	125,976	75,607	601,829	36,520	45,977	4,150	25,480
Miscellaneous	27,662	194,214	9,456	82,599	37,118	276,813	20,750	20,328	2,460	14,330
Totals for all manufacturing industries, mines, quarries and wells of U. S.	1,037,114	10,977,136	520,078	8,230,293	1,557,192	19,207,429	655,611	880,312	91,181	585,699

Table IV—Direct-Current Motor-Operating Voltages of Industrial Plants in the United States

Industry	Total Number of Companies Reporting on Direct-Current Motor Voltages	Number of Companies Reporting Various Motor-Operating Voltages — Voltages																						
		80	110	115	120	125	200	210	220	225	230	235	240	250	260	275	300	440	500	530	550	600	650	660
Chemicals and allied products	115	..	23	10	2	1	..	1	31	..	10	1	6	10	1	1	..	7	1	..	10	..	..	..
Electrical equipment and machinery	67	..	10	4	2	1	..	..	36	..	6	..	1	2	..	..	..	5	..	..	..	..	..	..
Food and kindred products	157	..	47	10	5	4	..	..	59	..	13	2	4	5	..	..	..	2	4	..	1	1	..	..
Iron and steel and their products	744	..	82	16	8	8	1	1	353	2	125	1	24	56	..	1	1	24	19	2	18	2	..	..
Leather and its products	52	..	16	1	1	1	..	..	23	..	6	..	1	1	..	..	..	1	1	..	..	..	..	..
Lumber and its products	124	..	30	2	7	6	1	..	54	..	4	..	1	7	..	..	..	5	2	..	5	..	..	..
Metals and metal products other than iron or steel	94	..	23	4	2	1	..	1	38	..	7	..	5	10	..	..	..	1	2	..	..	..	..	..
Mining, miscellaneous	200	2	1	..	..	2	..	1	26	..	8	..	1	127	..	6	..	5	10	..	11	..	..	..
Paper and printing	181	..	25	14	5	6	..	4	66	1	23	2	5	12	..	..	..	7	4	..	7	..	..	..
Railroad-shop construction and repairs	18	..	1	..	..	1	..	..	5	..	4	..	..	2	..	..	..	1	..	..	1	1	1	1
Rubber and its products	35	..	7	1	1	1	..	..	10	..	5	..	1	4	..	..	..	4	..	..	1	..	..	..
Shipbuilding	14	..	1	..	1	..	..	..	5	..	5	..	..	2	..	..	..	..	..	..	..	..	..	..
Stone, clay and glass	94	..	20	4	1	4	..	..	31	1	10	..	6	10	..	..	..	4	2	..	..	..	..	1
Textiles	312	..	76	28	10	4	..	1	114	2	24	..	7	12	..	..	..	5	17	..	12	..	..	..
Tobacco	4	..	1	..	..	..	..	..	2	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
Vehicles for land transportation	36	..	6	1	..	..	..	1	19	..	1	1	1	2	..	..	..	4	..	..	..	..	..	..
Miscellaneous	166	..	42	8	6	2	..	..	77	1	12	..	2	7	..	..	..	1	1	..	7	..	..	..
Totals for all industries of U. S. (reported)	2,413	2	411	103	51	42	2	10	949	7	263	7	65	269	1	8	1	77	63	2	73	4	1	2

industrial plants and mines of the country, such as were received by the ELECTRICAL WORLD, are, however, useless for practical purposes except as they may be made the basis for an estimate of the use of electrical energy by all the plants and mines of the country. The ELECTRICAL WORLD has accordingly made such an estimate for the various items covered in the survey, based upon the information given in the reports received and supplemented by federal census data. These estimates are presented in the accompanying tables.

For the first time in the history of the industrial utilization of electrical energy, the 1919 census data indicated that a major percentage of the energy used was purchased from public utilities as against private generation. The total consumption of electrical energy by the mills, factories, mines and petroleum fields of the United States during 1920 is estimated at 33,282,200,000 kw.-hr., of which 14,242,200,000 kw.-hr., or 42.8 per cent, was generated in private stations of the plants and mines. In 1904, less than twenty years ago, more than 72 per cent of the motor load was carried by private generating plants. In 1909 this percentage had dwindled to about 64 per cent and in 1914 to about 56 per cent, and at the present time it is only about 40 per cent. Such a remarkable growth in the use of central-station energy as against energy generated in private plants is an excellent testimony to the quality of service which the central station has been rendering and is rendering to the manufacturing and mining industries in general.

Based upon the returns received in the survey, it is estimated that there are 5,949 plants using more than 500,000 kw.-hr. of electrical energy per year. Iron and steel mills lead with 832 plants, and textile mills follow with 723 plants.

By far the largest user of electrical energy is the iron and steel industry, which in 1920 consumed 8,115,000,000 kw.-hr., or 24.4 per cent of the total electrical energy consumed for power purposes by the plants and mines of the country. The chemical and allied products industry is second, with a total consumption of 6,074,700,000 kw.-hr. The extent to which operations in all industries were curtailed during the late industrial depression is indicated by the large decrease in the amount of elec-

Table V—Alternating-Current Motor-Operating Voltages of Industrial Plants of the United States

Industry	Total Number of Companies Reporting on Alternating-Current Motor Voltages	Number of Companies Reporting Various Motor-Operating Voltages — Voltages																						
		110	115	120	125	200	210	220	225	230	240	250	400	440	460	480	500	550	600	1,100	2,200	2,300	2,500	Miscellaneous*
Chemicals and allied products	302	18	1	1	..	1	..	132	..	..	1	..	2	65	..	..	..	43	1	..	20	14	..	3
Electrical equipment and machinery	107	12	..	..	..	..	..	64	..	4	1	..	..	14	..	..	1	6	..	..	4	..	..	1
Food and kindred products	363	35	..	1	..	1	4	204	..	1	1	1	1	70	..	..	1	10	..	..	22	10	..	1
Iron and steel and their products	1,080	57	..	74	1	4	2	572	..	20	11	11	..	246	..	..	6	13	..	1	42	13	2	5
Leather and its products	125	10	..	..	..	..	..	79	..	..	1	4	..	13	..	1	1	12	..	..	1	2	1	..
Lumber and its products	295	22	2	1	..	2	..	157	2	1	..	4	..	61	..	4	2	16	1	..	13	7	..	..
Metals and metal products other than iron or steel	191	13	..	..	..	..	..	127	..	1	1	6	1	30	1	..	..	1	..	..	6	4	..	..
Mining, miscellaneous	185	4	..	..	..	..	..	53	..	1	1	1	..	64	..	..	..	1	..	1	36	17	..	6
Paper and printing	212	12	1	2	..	..	..	67	..	5	1	1	1	48	1	2	1	40	6	..	16	4	..	4
Railroad-shop construction and repairs	41	..	1	..	..	..	..	20	..	2	1	..	..	13	..	1	..	1	..	..	1	..	..	1
Rubber and its products	58	..	..	2	2	..	..	11	..	1	2	7	..	18	..	1	..	5	..	..	4	2	..	3
Shipbuilding	51	4	..	..	..	..	..	16	..	..	..	..	..	22	..	..	..	2	..	..	4	2	..	1
Stone, clay and glass	226	10	..	1	..	..	1	116	..	..	2	2	1	54	1	1	2	14	1	..	13	6	..	1
Textiles	962	56	1	6	..	7	5	481	2	2	7	10	1	88	1	1	4	205	13	2	30	32	..	8
Tobacco	32	10	..	..	..	1	..	20	..	..	..	..	..	1	..	..	..	2	..	..	1	1	..	..
Vehicles for land transportation	70	5	..	..	..	..	..	40	..	2	1	1	..	16	..	1	..	2	..	..	1	1	..	..
Miscellaneous	154	16	1	1	..	..	..	88	..	1	2	1	..	32	..	..	..	7	1	..	..	1	..	3
Totals for all industries of U. S. (reported)	4,454	284	7	89	3	16	12	2,247	4	41	33	49	7	855	4	12	18	378	23	4	213	115	3	37

* Miscellaneous voltages: 30 volts, 1; 90 volts, 1; 100 volts, 2; 117 volts, 1; 130 volts, 1; 160 volts, 1; 235 volts, 2; 280 volts, 1; 350 volts, 1; 370 volts, 1; 410 volts, 2; 420 volts, 1; 430 volts, 1; 450 volts, 2; 570 volts, 1; 660 volts, 1; 800 volts, 1; 980 volts, 1; 2,000 volts, 2; 2,100 volts, 1; 2,400 volts, 1; 3,500 volts, 1; 3,800 volts, 1; 4,000 volts, 2; 4,400 volts, 1; 5,500 volts, 2; 6,600 volts, 2; 10,000 volts, 1; 11,000 volts, 1.

Table VI—Size of Largest and Smallest Motors Installed in the Industrial Plants and Mines of the U. S.

Industry	Total Number of Companies Reporting on Size of Motors	Largest Motor Installed (Number of Companies Reporting)								Smallest Motor Installed (Number of Companies Reporting)						
		Under 10 Hp.	From 10 to 25 Hp.	From 26 to 50 Hp.	From 51 to 100 Hp.	From 101 to 200 Hp.	From 201 to 300 Hp.	From 301 to 1,000 Hp.	Over 1,000 Hp.	Under ¼ Hp.	From ¼ to ½ Hp.	From ½ to ¾ Hp.	From ¾ to 1 Hp.	From 1 to 2 Hp.	From 2 to 3 Hp.	Over 3 Hp.
Chemicals and allied products	427	35	82	122	107	59	11	11	0	18	96	32	55	49	54	115
Electrical equipment and machinery	161	19	65	35	19	10	8	5	0	30	66	22	22	10	2	8
Food and kindred products	557	91	178	126	78	54	12	18	0	26	148	80	104	67	47	68
Iron and steel and their products	1,857	78	480	463	392	161	64	73	46	116	450	282	336	176	193	290
Leather and its products	216	31	101	53	18	11	2	0	0	8	54	32	42	20	13	28
Lumber and its products	490	38	168	163	80	32	8	0	1	11	74	78	83	64	60	102
Metals and metal products other than iron or steel	298	24	112	73	50	12	7	11	7	34	91	35	49	35	28	26
Mining, miscellaneous	288	5	29	67	64	53	40	28	2	4	34	24	19	40	52	102
Paper and printing	362	72	96	53	44	50	23	23	1	22	137	50	44	32	30	38
Railroad-shop construction and repairs	60	0	7	17	17	11	1	7	0	4	12	11	4	6	8	13
Rubber and its products	75	5	5	5	11	13	17	17	2	12	24	8	18	2	2	2
Shipbuilding	44	1	1	1	5	12	6	17	0	7	11	10	6	1	4	5
Stone, clay and glass	336	36	74	74	58	62	14	18	0	16	58	31	40	48	40	101
Textiles	1,474	450	448	268	187	95	17	7	2	53	240	221	194	154	143	319
Tobacco	50	24	19	6	1	0	0	0	0	2	14	8	6	6	4	5
Vehicles for land transportation	118	13	35	30	19	11	5	5	0	6	29	20	19	10	10	19
Miscellaneous	343	69	138	68	32	21	11	4	0	30	109	55	33	33	28	29
Totals for all industries of U. S. (reported)	7,156	991	2,038	1,624	1,182	667	246	244	61	399	1,647	999	1,070	753	718	1,270

Table VII—Frequencies Used in Industrial Plants and Mines of the United States

Industry	Total Number of Companies Reporting on Frequency.	Number of Companies Reporting Various Frequencies Used (The first figure gives number of phases; the second figure the number of cycles)														
		1–25	2–25	3–25	3–30	1–40	2–40	3–40	1–50	2–50	3–50	1–60	2–60	3–60	4–60	2–100	3–120
Chemicals and allied products	329	2	2	18	..	..	..	4	1	..	4	14	48	236	..	..	..
Electrical equipment and machinery	137	..	2	2	..	..	..	1	..	..	2	8	20	102	..	..	..
Food and kindred products	378	..	1	18	2	..	..	2	..	1	25	24	38	266	1	..	..
Iron and steel and their products	1,471	1	..	118	7	..	..	7	1	1	16	47	192	1,079	1	..	1
Leather and its products	132	1	..	5	..	..	..	1	..	..	..	2	22	100	..	1	..
Lumber and its products	351	2	..	8	8	..	..	6	..	..	2	11	46	268	..	..	..
Metals and metal products other than iron or steel	228	1	1	18	7	..	..	1	..	..	..	12	46	142	..	..	..
Mining, miscellaneous	186	..	..	7	..	..	..	..	..	..	..	4	8	167	..	..	..
Paper and printing	221	..	..	24	1	..	..	12	..	1	..	8	23	152	..	..	..
Railroad-shop construction and repairs	51	..	..	7	1	..	..	1	..	..	..	..	8	34	..	..	..
Rubber and its products	59	..	1	1	..	..	..	..	..	..	..	10	5	42	..	..	..
Shipbuilding	42	..	..	1	..	..	..	..	..	..	4	2	4	31	..	..	..
Stone, clay and glass	253	..	..	13	2	1	..	4	..	..	3	7	42	181	..	..	..
Textiles	1,001	..	1	20	4	..	5	24	1	2	6	35	182	720	1	..	..
Tobacco	30	..	2	..	..	..	..	..	..	..	1	8	11	8	..	..	..
Vehicles for land transportation	93	..	..	1	1	..	..	..	1	..	2	4	11	73	..	..	..
Miscellaneous	195	..	..	5	1	..	1	1	1	..	..	17	24	145	..	..	..
Totals for all industries of U. S. (reported)	5,157	7	10	266	34	1	6	64	5	5	65	213	730	3,746	3	1	1

Table VIII—Prime-Mover and Boiler Equipment of Industrial Plants and Mines of the United States

(Prime-mover data from U. S. Census of Manufactures for 1919; boiler data estimated by "Electrical World")

Industry	No. of Plants Using Mech. Power	Total Hp. of Prime-Movers in Industrial Plants*	Steam Engines		Steam Turbines		Internal-Combustion Engines		Waterwheels		"Electrical World" Estimate of Boilers in Industrial Plants	
			No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Agricultural implements	497	80,407	303	51,107	31	18,835	166	4,092	72	6,370	226	52,800
Chemicals and allied products (total)	10,487	2,162,852	13,810	1,350,292	1,707	634,159	2,577	148,665	491	27,892	9,343	2,216,000
Rubber and rubber products	494	236,747	491	120,773	67	106,401	40	3,859	29	5,545	823	221,000
Glass and glass products	1,481	162,548	459	83,893	29	22,646	420	53,458	231	2,545	407	96,000
Chemicals	4,140	500,329	3,225	302,595	366	174,861	725	14,720	133	7,748	2,480	587,000
Smelting and refining of metals	171	291,008	505	159,749	110	119,151	69	4,208	10	7,900	900	211,000
Artificial gas manufacture	767	206,091	2,868	148,393	650	49,928	151	7,574	1	12	1,066	248,000
Miscellaneous chemical industries	3,434	766,129	6,262	534,889	485	161,172	1,172	64,846	87	4,142	3,667	853,000
Electrical equipment and machinery	1,345	202,477	274	62,000	51	131,231	103	7,446	16	1,795	342	109,500
Food and kindred products	52,086	2,088,839	21,553	1,580,432	953	133,478	8,603	179,700	4,882	192,987	7,400	1,752,000
Iron and steel and their products	17,502	5,612,754	11,551	3,896,407	1,247	1,024,661	3,561	649,688	521	39,577	15,900	3,722,000
Leather and its products	4,718	242,891	1,637	191,363	146	38,092	234	8,403	64	5,004	896	184,000
Lumber and its products	36,865	3,008,512	38,973	2,618,388	806	252,309	3,411	59,325	1,733	77,200	18,200	3,580,000
Liquors and beverages	5,821	324,745	3,599	304,567	92	11,269	890	7,556	12	1,091	1,364	323,000
Metals and metal products other than iron or steel	9,547	462,920	1,553	295,773	164	132,286	947	25,438	146	9,243	1,447	332,200
Bituminous and anthracite coal mines	5,670	2,167,843	14,488	1,898,788	358	246,444	1,323	22,537	9	74	11,920	2,547,000
Metal mines	1,930	864,451	4,001	556,274	131	192,244	1,463	81,483	266	34,450	4,160	889,000
Stone quarries	1,490	219,938	3,397	194,477	23	14,286	440	9,045	18	2,130	1,160	248,000
Miscellaneous mines and quarries	956	120,153	1,343	73,108	43	21,341	425	20,874	34	4,830	524	112,000
Petroleum and natural gas	8,170	1,775,228	23,515	536,429	0	0	53,766	1,238,759	2	40	2,980	636,500
Paper and printing	30,261	1,764,352	3,809	664,519	283	146,656	4,571	23,693	2,655	917,932	3,113	874,000
Railroad-shop construction and repairs	2,068	486,742	2,671	389,032	169	86,370	185	10,399	6	498	1,710	418,000
Stone and clay and their products	9,800	915,392	7,335	737,965	154	91,827	2,872	69,874	109	15,239	3,167	747,500
Textiles	27,702	2,301,160	6,603	1,383,171	504	453,210	657	15,283	2,330	448,327	7,720	1,802,000
Tobacco	1,299	28,960	238	25,881	10	2,332	32	345	9	279	627	78,600
Vehicles for land transportation	19,654	230,242	947	121,604	68	70,548	3,715	35,456	75	2,591	960	254,800
Miscellaneous	8,203	219,841	1,301	167,243	87	30,972	882	14,031	123	7,523	1,137	236,000
Total for all manufacturing industries, mines, quarries and wells of U. S.	256,071	25,280,699	162,901	17,098,820	7,027	3,732,550	90,823	2,632,092	13,573	1,795,072	94,296	21,114,900

* Includes water motors.

Table IX—Types of Motor Control Used in Industrial Plants and Mines of United States

Industry	No. of Companies Reporting on Motor Control	Number of Companies Reporting Various Types of Motor Control: Snap Switches	Knife or Safety Switches	Auto-Starters	Magnetic Switches	Remote Control	Circuit Breakers
Chemicals and allied products	361	71	260	196	88	70	163
Electrical equipment and machinery	142	69	121	80	41	30	47
Food and kindred products	448	116	367	222	101	60	194
Iron and steel and their products	1,645	410	1,357	958	431	379	753
Leather and its products	180	46	156	74	49	24	66
Lumber and its products	402	79	337	170	66	34	146
Metals and metal products other than iron or steel	264	71	224	139	55	42	101
Mining, miscellaneous	239	49	176	146	89	44	185
Paper and printing	313	94	260	155	78	82	146
Railroad-shop construction and repairs	53	14	44	37	14	17	26
Rubber and its products	52	24	47	40	27	28	34
Shipbuilding	44	13	29	30	10	12	18
Stone, clay and glass	290	58	214	140	65	53	121
Textiles	1,094	284	848	482	161	102	446
Tobacco	34	12	31	16	2	2	11
Vehicles for land transportation	102	26	78	56	30	29	45
Miscellaneous	285	90	236	119	58	56	118
Totals for all industries of U. S.	5,948	1,526	4,785	3,060	1,365	1,064	2,620

trical energy consumed in 1921 as compared with 1920 and shown in Table II.

There are 1,557,192 electric motors installed in the factories and mines of the country, with a total rating of 19,207,429 hp. Of these motors 655,611, or 42.1 per cent, are under 5 hp. About 56.6 per cent of the machines are belt-driven, 37.5 per cent are directly connected, and only 5.9 per cent are chain-driven.

Perhaps one of the most noteworthy facts resulting from the data collected through the survey is the large number of voltages in actual use in the operation of motors. It is apparent that there is much remaining to be done toward the standardization of voltages in the country at large. The 6,504 companies reporting motor-operating voltages indicate that there are twenty-three voltages in use for the operation of direct-current motors and fifty-one voltages in use for the operation of alternating-current motors. It appears that about 39 per cent of the direct-current motors are operated at 220 volts, but a large percentage are also operated at 110, 115, 230 and 250 volts. Iron and steel mills particularly reported a high percentage of direct-current motors operated at other than 220 volts. Approximately one-half of the alternating-current motors are operated at 220 volts, and about one-fifth are operated at 440 volts. Three hundred and twenty-eight plants reported the use of primary voltage (i.e., 2,200 volts or 2,300 volts) for operating alternating-current motors.

A careful study of the tabulated returns indicates that a very high percentage of the odd voltages are in use in plants generating their own energy. As a rule only standard voltages are reported by companies purchasing their energy from central stations. This difference is due in large part to the fact that a considerable proportion of the private generating plants have antiquated equipment as compared with the up-to-date central-station equipment. Ohio and Pennsylvania appear to be in most need of voltage standardization.

Out of a total of 7,156 companies reporting on size of motors, about 43 per cent indicated that the largest installed motor was under 25 hp. About 23 per cent of the companies reported that the smallest motor installed ranged between $\frac{1}{8}$ hp. and $\frac{1}{4}$ hp.

It is estimated from the reports of 4,307 companies that there are 667,770 refillable or renewable fuses used monthly by the industries covered in the survey. Standard fuses total 356,330 per month, or a total of 1,024,100 fuses of both general types per month.

Field for Future Electrification

The electrical industry as a whole is, perhaps, most interested not so much in the past growth and present status of the electrification of industry as in the length and breadth of the field for future electrification. A study of the prime-mover data presented in Table VIII indicates that the industrial field of the central station is only about one-third developed. It is, of course, too much to assume that in course of time all industry will be electrified, or that the private plants will cease to exist, but, notwithstanding these facts, a large field for future industrial power growth is open to the central generating station.

Although the iron and steel industry far outstrips any other in the consumption of electrical energy, there are several other primary industries which are more highly electrified by central-station energy. The data indicate that the so-called "chemicals and allied products industry" is the most highly electrified from central-station energy. This highly diversified industry is 36.4 per cent electrified, not considering that portion using energy generated in private plants. The food industry is also a large patron of the central station, being 33.5 per cent electrified by central-station energy.

Table X—Types of Fuses Used in Industrial Plants and Mines of the United States

Industry	Total Number of Companies Reporting on Fuses	Standard Fuses: Number of Companies Using This Type	Fuses Used per Month: Number	Number per Motor	Refillable and Renewable Fuses: Number of Companies Using This Type	Fuses Used per Month: Number	Number per Motor	"Electrical World" Estimate of Fuses Used per Month by All Industrial Plants of U. S.: Standard	Renewable and Refillable
Chemicals and allied products	254	127	4,615	0.781	218	13,480	0.865	28,400	84,400
Electrical equipment and machinery	112	65	28,900	0.506	72	10,080	0.701	31,500	11,380
Food and kindred products	343	166	8,720	0.883	239	7,330	0.667	75,600	63,770
Iron and steel and their products	1,291	540	15,100	0.612	1,058	56,240	0.623	38,380	142,700
Leather and its products	154	68	1,527	0.673	131	5,050	0.971	7,050	23,400
Lumber and its products	314	126	1,943	0.808	265	5,190	0.621	12,480	33,200
Metals and metal products other than iron or steel	197	99	2,540	0.988	152	6,920	1.011	20,050	57,300
Mining, miscellaneous	154	49	582	1.350	127	2,970	0.815	10,640	54,000
Paper and printing	217	116	3,520	0.416	164	3,070	0.558	47,400	41,300
Railroad shop construction and repairs	48	20	1,435	1.273	41	2,400	1.087	19,230	32,200
Stone, clay and glass	227	83	1,858	0.705	182	4,815	0.690	5,680	14,730
Textiles	701	346	12,640	0.518	496	8,200	0.238	48,700	31,600
Tobacco	28	16	144	1.290	25	77	0.341	2,240	1,190
Vehicles for land transportation	86	22	733	0.743	77	7,820	0.711	4,630	42,400
Miscellaneous	181	82	1,077	0.558	146	7,020	0.960	4,350	28,200
Totals for all industries of U. S.	4,307	1,925	85,334	0.807	3,393	140,662	0.724	356,330	667,770

Active Year in Power Transmission

By Percy H. Thomas
Consulting Engineer, New York City

Cost of Superpower Lines Not Prohibitive—Excessive Conductor Pulls Should Be Relieved—Tendency to Omit Circuit Breakers, Arresters and Ground Wires — Stabilizing Line Potential — Corona as a Limit

THE year just past has been one of seasoning in the high-tension transmission field rather than a year of new undertakings. After such advances as the Murray superpower report and the 220,000-volt transmission projects in California, a pause for digesting the new ideas and the working out of details was appropriate.

For example, a considerable amount of sober study has been given to the practical aspects of very long transmission systems, such as those proposed in the superpower report between the St. Lawrence and the Niagara power sites and the seaboard. These projects seem surprisingly simple as the plans have worked out, and their cost is by no means prohibitive. Attention may be profitably given to the operating features, starting, interruptions, lightning protection, etc.

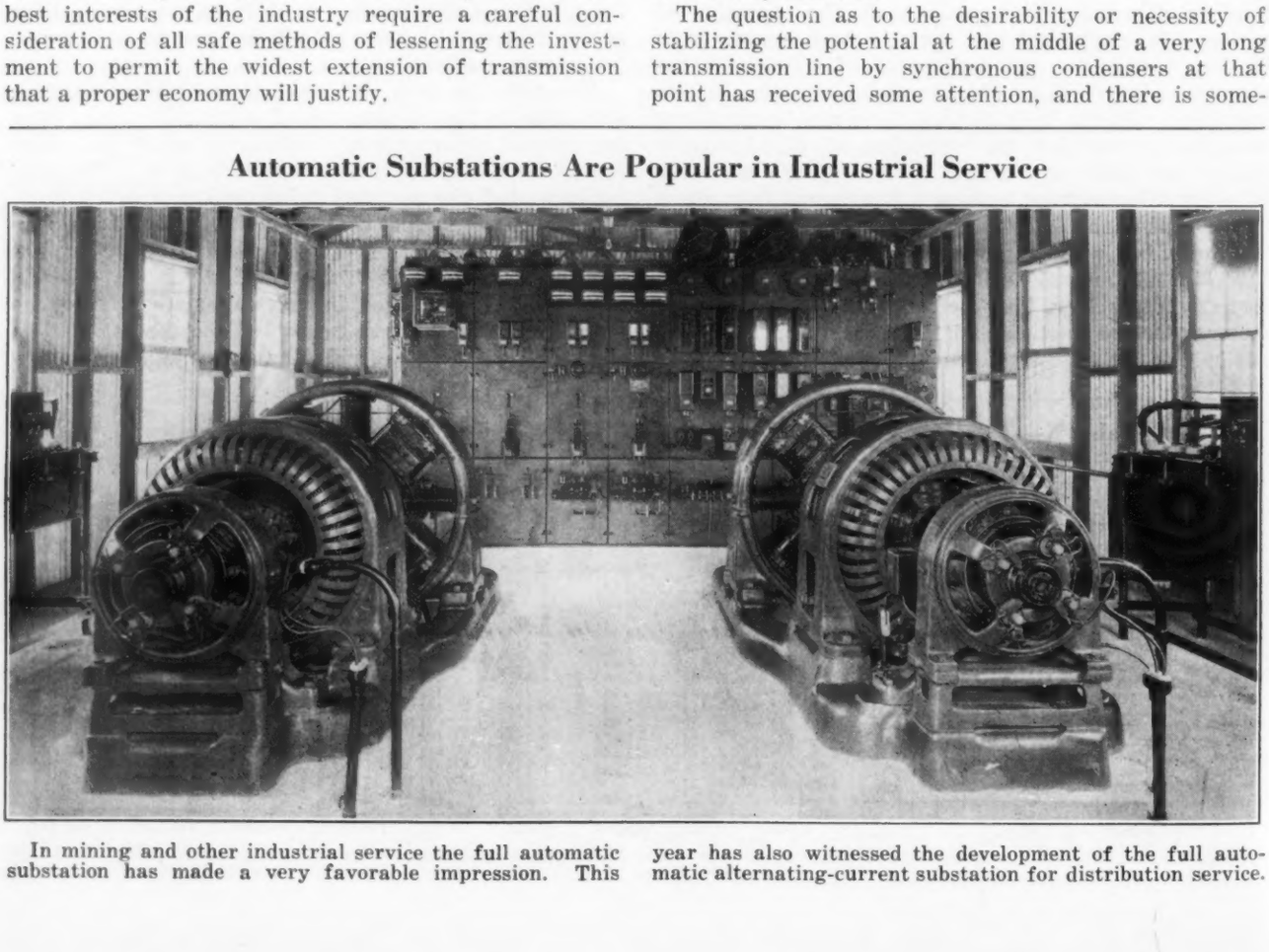
As far as line structures go, there are no new problems of magnitude involved. On the other hand, with the ever-extending systems an opportunity is presented of introducing innovations for lessening costs. The best interests of the industry require a careful consideration of all safe methods of lessening the investment to permit the widest extension of transmission that a proper economy will justify.

One detail of very great importance in the design of super-transmission lines is the so-called suspension clamp. Very strong conductors are used with such lines, and if the towers are to be designed to withstand the full stress on broken conductors, they will be extremely expensive and very heavy. On the other hand, if these clamps are so designed as to allow the conductor to slip when there is an excessive pull, and if the tower be designed to take advantage of this fact, a great deal of weight and cost can be saved.

One question that is receiving consideration is the omission of high-tension oil breakers in super-tension transmission systems, such as those employing 220,000 volts. Where such breakers are used at the ends of very long lines the openings of the breaker on one end of a line, when excited at the other, will cause an excessive rise of potential on the open end. With no chance of the circuits being opened the control of such a condition is much easier; furthermore, the saving of cost is very material.

The question as to the desirability or necessity of stabilizing the potential at the middle of a very long transmission line by synchronous condensers at that point has received some attention, and there is some-

Automatic Substations Are Popular in Industrial Service



In mining and other industrial service the full automatic substation has made a very favorable impression. This year has also witnessed the development of the full automatic alternating-current substation for distribution service.

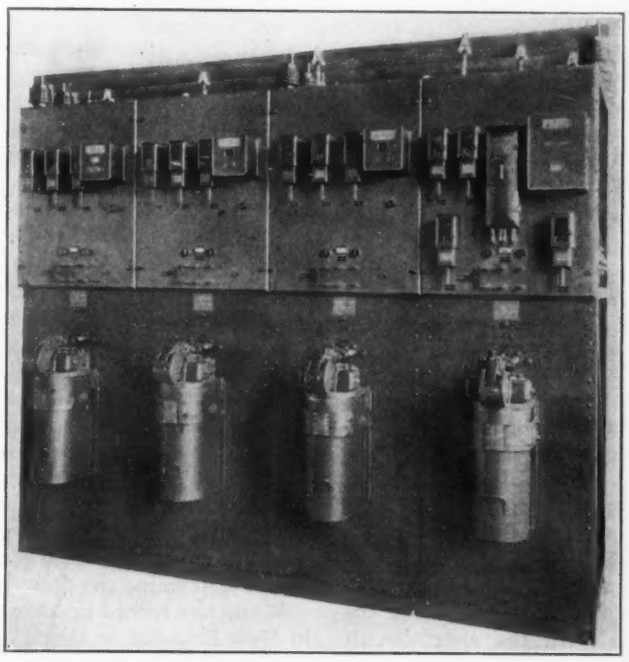
thing to be said both pro and con. The omission of the middle-point station certainly simplifies the operation very much and cheapens the cost. On the other hand the handling of the charging current and the tendency of the potential of a long line to "bow up" in the middle of the line are much helped by the stabilization of the middle point. Furthermore, if the load transmitted is not properly proportioned to the voltage of the line, bad regulation and efficiency result without the middle-point condensers.

The significance of corona as a limitation in transmission is now being fully realized. For 220,000 volts a conductor diameter of approximately 1 in. is required with the usual spacings, but a conductor of this diameter in copper represents a lower resistance, and hence higher cost, than is warranted by any power that can be transmitted with a reasonable drop over the line on account of the reactance of the line. The same statement applies to aluminum conductors, though to a less extent. The use of a steel core in the aluminum restores the balance, however, and presumably the same thing will be done by using a steel core with copper. The use of the copper with a rope strand, which very materially increases the diameter, gives another solution, as is shown by its use in the Pit River transmission system. When we pass to 260,000 volts, corona requires a diameter of approximately 1.15 in. with a resistance of 75 per cent of the resistance of the inch diameter conductor, while the reactance of the cable is not greatly changed. This means a still greater disproportion between resistance and reactance, which requires more radical modifications of conductor design. There has been a great activity in large transmission systems in foreign countries, new machinery having been partly supplied by United States and partly by foreign manufacturers, although the extra-high-tension equipment was furnished largely from this country. Notable installations are the 150,000-volt line in Formosa designed to withstand typhoons with a wind velocity up to 150 miles per hour, the large steam development in southern Australia and the system of the Compañia Chilena de Electricidad, Ltd., of Santiago, Chile. The latter plant, started by Chilean capital and afterward merged with a larger system controlled by English capital, has just completed a 34,000-hp. station and 110,000-volt transmission line to the city of Santiago and is extending this to form a network over central Chile. This plant, which will supply the power for the electrification of the Chilean State Railways, contemplates development in the near future to approximately 100,000 kw. installed capacity. This is a very notable installation for South America.

Foreign plants as well as American plants have been seriously short of power to supply their demands.

Among the contributions of the past year to the technical societies one of the most notable bearing on the subject of transmission was the paper of R. J. C. Wood* before the Pacific Coast convention of the American Institute of Electrical Engineers. This paper gives the results of careful studies that have been made by the Southern California Edison Company for converting its 150,000-volt Big Creek transmission system into a 220,000-volt system and the tests on its 27-mile trial 220,000-volt line. These studies constitute the most practical and constructive contribution to the data on 220,000-volt transmission that has appeared in some time, and a very brief summary may be permitted here. The adaptation of the company's existing 150,000-volt generating station to the converted 220,000-volt line is accomplished by auto-transformers, star-connected, with neutral grounded and a large capacity tertiary winding. Similar auto-transformers are used at the receiving end, but with a ratio of approximately two to one. This is mentioned as a notable though unusual expedient and as solving an awkward condition. The paper summarizes the tests made on insulator strings, and the conclusion arrived at was that by using ring shields around the line unit the same insulator string might be used on 220,000 volts as had been used on 150,000 volts without any greater strain on the unit most stressed than was the case before. Very possibly if new towers had had to be built a somewhat different layout might have been adopted. It will be found of interest to compare these insulator studies with those described by Frank Baum at Salt Lake City in 1921.

Marked Improvements in Relays and Breakers



The reclosing circuit breaker for feeder service and the development of more rugged and simpler relays have increased the reliability of service.

CORONA LOSS SHOWS UNIFORMITY

The careful and illuminating measurements of corona loss on this 27 miles of test line check very satisfactorily with the Peek formulas as to form, with some irregularities as to temperature. The constant M_o varies from about 0.7 to over 0.9 between storm conditions and fair-weather conditions. This is about the same range as Peek's values.

It is interesting to note that the charging current of the 27-mile test line equipped with rings is 7½ per cent

*See the ELECTRICAL WORLD for Feb. 11, 1922, page 277.

more than the theoretical charging current of the conductors alone. It was surmised that this was due to the guard rings and the effect of insulator surfaces. There is a growing tendency to eliminate overhead ground wires, and even lightning arresters, especially on lines operating at very high tensions. This change is not based on any concrete evidence from operation, but on the gradual realization of the great cost and complication of the arresters and the limited usefulness that they can have. The trend during the next year will be watched with interest by all operating engineers.

Among the less important growths in practice may be mentioned the more general use of tertiary windings to suppress the third harmonics in certain cases and to serve for the supply of a synchronous condenser or to insure a positive three-phase short circuit with a single-phase ground. The necessity of having the tertiary winding of sufficient capacity or adequately protected to stand the heating effects of circulating current due to such a single-phase ground is now recognized as some burn-outs have occurred with low-capacity tertiary windings.

High-tension disconnecting switches are now often made for group operation from remote handles and may be interlocked to prevent careless operation. They may also be made for operation by motors.

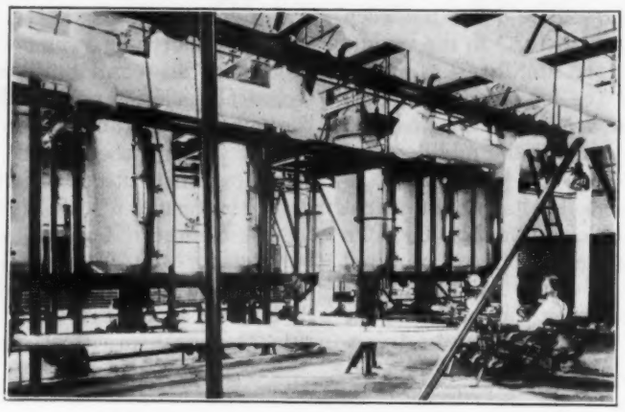
The number of 130,000-volt and 150,000-volt lines steadily increases, with new ones in Brazil and New England.

Steady progress is being made in the study of relays, and their performance has been more reliably and accurately determined. It is possible by co-ordinating the selection and setting of relays with the short-circuit kva. that may be expected at various points in a system, as derived from calculation, to get selective and reliable protection. This has been more difficult in the past. A most important test† of oil breakers was made on the lines of the Consolidated Gas, Electric Light & Power Company's system at Baltimore last year. A full and careful set of tests was made on two makes of breakers of various types, and oscillographs were taken of current and voltage so that their performance was known under definite conditions. The breakers on the whole did well, but as a consequence of the tests a distinct improvement has been made in the way of preventing the throwing of oil, which has been a limiting and troublesome feature. It is a remarkable fact that these tests were made in part on the main system simultaneously with normal operation and without material disturbance of the regular consumers. These tests, while, of course, very technical in their nature, are of very great value to the art. They were described in papers before the A. I. E. E. at the Niagara convention and caused spirited discussion.

During the year there has been some discussion of the theoretical performances of very long lines with lengths up to 3,000 miles, and the periodic character of the typical line has been brought out. That is, the generator voltage, current and power factor of a line delivering a fixed load at a fixed voltage do not increase by regular curves as the lines become longer and longer, but have alternately rising and falling values, according to the relation of the length of the line to its wave length for the frequency used. A 60-cycle line has a wave length of about 3,000 miles, so that a line of that frequency will have a very wide range of regulation with variation of load when of quarter-wave length, or 750 miles, and a very narrow range of regulation with change of load at half-wave length, or 1,500 miles, and again a wide range at three-quarters wave length, or 2,250 miles. These characteristics may have an important bearing on transmissions exceeding five or six hundred miles and may in the more or less distant future determine the frequency of a circuit.

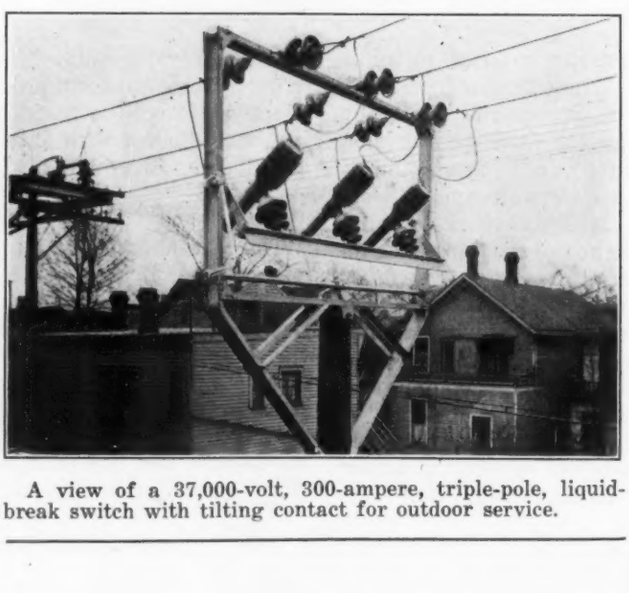
While the record-breaking sleet storm which occurred in New England in the fall of 1921 does not, of course, belong to the year just past, it may be well to turn again to the lessons learned from it. It was proved once for all—though perhaps for the second or third time—that it is not feasible to build transmission lines against any possible sleet; a reasonable compromise must be made. This being the case, is it not incumbent on the industry to make the fullest practicable use of substitute methods, such, for example, as the melting off of sleet? The sleet load is the determining factor in transmission line design and melting methods are needed.

Electric Heating Used



The use of electricity for heating water is limited to special conditions, but this view shows the attractive appearance of a plant containing two 30,000-kw. boilers.

Outdoor Switches Are Improved



A view of a 37,000-volt, 300-ampere, triple-pole, liquid-break switch with tilting contact for outdoor service.

†See ELECTRICAL WORLD for July 1, 1922, page 21.

Future Policies of Smaller Utilities

By H. H. Hunt
Vice-President Stone & Webster, Inc.

Greater Saturation of Investment, More Economical Supply, Better Distribution Engineering and Administrative Skill Essential to Their Safety and Growth

I HAVE been asked to outline the probable trend of development in equipment and administrative policies of small and medium-sized central-station companies during the next few years. The service furnished by such properties is no longer a luxury but one of the essentials of every-day life in all but the smallest isolated communities. Unreliable service from crude and inefficient equipment at high rates and in correspondingly small volume is no longer tolerated. The public today is demanding dependable and closely regulated service in unlimited quantities and at reasonable rates wherever electric transmission or distribution lines are within reach.

Maximum Use of Investment

The fundamental problem today of public utilities large or small is that of making every dollar of investment yield the greatest and most efficient possible service. Since pre-war days there have been radical changes in the conditions under which central stations operate. We have come to recognize fairly well-defined limits of investment which could be profitably made to yield a dollar of revenue. The unit investment in central stations today is at least 60 per cent greater than in 1914. Much of the new equipment which was demanded during the war period cost considerably more than this. Contrary to the hopes of many people, there appears to be slight prospect of any great downward trend of construction costs for a considerable number of years. During the period of higher prices the average rates charged by central-station companies have increased approximately 20 per cent, and the pressure for reduction of present levels in rates has already begun in spite of the prevailing and anticipated abnormal costs of fuel and the inability of the central stations so far fully to recover the losses sustained early in the period of rising costs before rate increases were authorized.

With such a substantial change in the ratio of investment to revenue as above indicated, central stations are faced with the serious problem of making each unit of equipment assume greater burdens than heretofore or to improve the load factor of the system and thereby secure more revenue per unit. Undoubtedly both these efforts must be made if the former ratios of investment to revenue are to be restored.

With respect to more intensive use of investment, it is evident that central-station experiences during the war period, when rapidly increasing demands for service called for continuous use of practically all available reserve equipment, demonstrated that previous conceptions of required reserve capacity were unnecessarily liberal, and that, with present standards of reliability, an increasing proportion of available equipment may be kept regularly employed. In this way each unit of station capacity may yield greater average output and greater revenue. The same is true of distribution transformers and, to a less extent, of distribution lines. Careful studies of transformer loads, particularly in the case of smaller systems, commonly show underloading and corresponding excessive losses. There is a profitable field of investigation in the methods and standards of distribution construction, with opportunities for simplification and greater reliability, together with reduced investment per unit of product distributed. With growth in their output even the smaller stations may profitably consider the use of larger generating units than have heretofore been available, with their lower cost per kilowatt and higher efficiencies. The extent to which refinements in efficiency through higher steam pressure, superheat, vacuum, better heat balances, etc., are justifiable in smaller stations is a matter for careful engineering study in each case.

Advantages of Interconnection

In spite of possible improvement in efficiencies of small central stations, there is a wide margin between them and the very large stations which are being built throughout the country. This raises the question as to the future field for the small generating plant as a competitor with so-called superpower plants with their vast transmission networks. Even in localities where power supply from remote steam or hydro-electric sources is not economical, there are still possibilities of economy by interconnection with adjoining systems through which combined reserve capacities may be reduced and maximum advantage taken of the highest generating efficiencies and diversities in the combined systems. The advantages so far demonstrated by interconnections between neighboring systems clearly indicate that the future should see a large expansion of this policy, accompanied by the abandonment or curtailed operation of many small steam plants or their conversion into substations. The perfection of automatic devices and of outdoor types of transforming and switching equipment will doubtless mean that many of these new installations will be of the self-operating type, installed at low cost and lacking many complicated and expensive features which have heretofore been considered necessary.

The more intimate future relationship between smaller central stations suggests the advantage of common administration, and it is to be expected that centralized management will extend its advantages, already enjoyed by more than 75 per cent of the central-station investment in this country, to many now independent

properties. It is to small properties of this character that centralized management offers the greatest opportunities through furnishing to the group of managed properties the administrative skill, purchasing capacity and engineering, construction and financing resources which no one of them alone could command, thereby producing savings which will permit the continued supplying of electric service under conditions as to rates and service which are satisfactory to the public.

Financial Prospects

With respect to financing policies of the future, it is gratifying to note that central-station companies have emerged from the period of almost prohibitive costs and restricted supply of capital and are now able to procure at fairly satisfactory rates the funds necessary for the reasonable and economic expansion of their properties. Throughout the war period it was necessary for public utilities to do a large part of their financing through the sale of short-term, high-interest-bearing notes, the balance being done through the sale of bonds. This resulted in an unbalancing of the financial structure of these properties, calling for early efforts at readjustment. Fortunately it is now possible for a large proportion of the central-station companies to undertake new financing through the sale of junior securities, at present preferred stocks with a tendency toward common stocks. The customer-ownership movement has made rapid strides and accomplished remarkable results in improving public relations, as was clearly demonstrated by the defeat of the proposed state ownership of water powers at the recent California election. Sale of junior securities, particularly common stock, of small central stations may not now be practicable on a large scale, but it is to be expected that the next few years will see satisfactory development in this direction.

The economies in construction, management and financing above considered will not in themselves be sufficient fully to restore to central stations the credit standards which they need. There must be, in addition, intensive studies of operating methods and economies. A promising and important field is in power-generating costs. A considerable number of central stations have undertaken power-station betterment work with gratifying results. Specific cases show reductions in switchboard costs amounting to from 20 to 40 per cent. Such gains are possible only through immediate supervision of operations by skilled engineers, a systematic maintenance program and continued regular scrutiny of operating results by a supervisory staff.

Under present disturbed coal conditions fuel oil offers attractions to many central stations. Because of the large initial investment necessary for conversion from coal to oil fuel the lower cost of the fuel itself does not offer the same advantages to small, low-load-factor stations as it does to large plants; and so the question of fuel for the smaller plants requires careful engineering analysis as well as forecasts of future fuel conditions. Because of their limited resources, small properties cannot safely undertake as radical changes in operating methods and policies as might be permissible under certain conditions for larger systems. This applies not only to power supply but to all phases of the company's business.

A feature by no means negligible in the administration of public utility properties is good housekeeping. Clean and attractive offices, power plants and premises improve the morale of the organization, produce increased efficiency and promote favorable public relations.

Helpfulness of Appliance Load

The more intensive use of central-station investments required for their continued profitable operation calls for more careful future attention to commercial policies. Creditable progress has been made in improving system load factors and diversities by increasing the large power loads. Many central stations have also carried on active appliance campaigns and have placed many devices in customers' homes. To a large extent these devices are more helpful to the central station in demonstrating the necessity and convenience of central-station service than as revenue producers. The annual revenue from many of the popular appliances, such as vacuum cleaners, washing machines, etc., is quite small, and, in view of the losses commonly incurred in the selling of these appliances, the question may well be raised whether the sales efforts could not more profitably be directed to service applications involving greater energy requirements. Cooking and refrigera-

Rehabilitations and Extensions Occur in Street Lighting

The increased use of multiple feed, greater intensities and the use of prismatic and non-dust accumulating reflectors have improved street lighting

tion are two promising fields of this character, and with further improvements in available equipment, the revenue possibilities of the central station from these sources should be substantially increased.

The problem of serving many small scattered customers is one that vitally concerns the smaller central stations, as does also the problem of outlying extensions. Carefully developed standards of rural construction, involving safety but low investment, are problems to be solved. The investment on customers' premises in service, meters, etc., costing more in many cases than the entire balance of the company's investment for the customer's service, is a large factor in high customer cost. With no prospects of substantial reduction in actual customer investment under present standards of metering, the solution of the problem of high customer cost would seem to lie in greater customer consumption.

It is the general practice of large central stations to prepare budgets covering both operation and construction, the latter looking ahead for a considerable term of years. Such budgets should also be prepared for smaller companies. They are just as important in small properties as in large ones because of the narrower margin of resources already referred to. A forecast of capital requirements and the possibilities of meeting the increased fixed charges thereon is particularly important.

Although small central stations have peculiar difficulties and problems which larger systems escape, they have advantages in possibilities of more intimate personal contact between customers and the operating organization which should make for more harmonious public relations. If these companies bring to bear upon their peculiar problems, including greater saturation of investment, more economical power supply and better distribution engineering, the best administrative skill which they can obtain, directly or through association with other similar properties, they will be able to maintain the confidence of both customers and investors upon whom they depend and to meet promptly the recurrent calls for expansion which are incident to the growth of every community, however small it may be.

The narrowing margin of profit brought about by the high cost of construction and operation and the more complete regulation by the public through public utility commissions and other similar agencies calls for thoroughly scientific management of all phases of the public utility business.

Economies of Interconnection

Vast Possibilities for Safeguarding Service and for Producing Electricity with Minimum of Fuel, Water, Money, Material and Human Endeavor—Typical Examples Taken from Actual Practice

IT IS chiefly because of the diversity of use of service that electric light and power stations can exist. High station load factor is a goal worth striving for, since it makes for efficiency of production and maximum use of investment, and if high station load factor is coupled with maximum system diversity factor, the goal is doubly attractive.

Now just as one office building may differ from another office building in load characteristics, so may one system differ from another system, and by combining the two certain economies become possible. Thus a block system is better than several isolated plants. A central station is an improvement on the block system. A superpower station is more economical than several small central stations, and an interconnected superpower system represents the highest development of the art. Ignoring all other possible economies, the saving in investment in reserve plant alone often warrants the interconnection of systems even though no power be normally transmitted over the tie lines.

It is essential that greater use be made of present investments in electric public utilities because the time is not far distant when the demands for service will far outrun the ability of the industry to command the necessary funds with which to provide that service. Thus efficiency in the use of money will be exacted of the electric light and power industry just as economy in the use of fuel, oil and water is insisted on in every-day operation, and there is every reason to expect the industry to show the same skill in the use of one as in the other. Up to the present perfection has been sought along engineering and operating lines and financial considerations have not received their just due.

The problem facing the electric public utilities of the country, however, is broader still and embraces the conservation of fuel, water, labor, money, materials and human endeavor. In a measure interconnection encompasses many of these and most of the advantages to be gained through it have fortunately already been demonstrated in practice. Only those, however, who have experienced the benefits of interconnection have any idea of its maximum possibilities.

The Boston-Washington Superpower Survey made by the national government showed the immense savings attainable through interconnection in the restricted area studied. But interconnection is no new expedient so that those contemplating it need not rely on academic studies for proof of its efficacy. Vast interconnected networks have been in existence for some time, notably in California, in Washington and Oregon, in Illinois and Wisconsin, in Michigan, Texas, Tennessee, Alabama, Georgia, South Carolina, North Carolina, Pennsylvania, and throughout the New England States and New York, and the results obtained in every case have more than surpassed expectations. In few of the existing interconnected systems, however, have the maximum attainable advantages been approached.

ADVANTAGES OF INTERCONNECTION

The beneficial effects of interconnection may be summarized as follows:

1. Interconnection makes possible the fullest utili-

zation of water powers and watersheds through exclusive hydro-electric systems or in hydro-electric systems operated as auxiliaries to large steam-electric systems. It also enables the interconnected system to take advantage of the diversity existing between watersheds and water storage.

2. Interconnection materially increases the load which may be carried on otherwise separate systems owing to diversity in peaks. This increase ranges from 15 per cent to more than 30 per cent.

3. Interconnection enables a generating system to operate with less equipment in reserve, and in fact in very large interconnected systems no reserve equipment need be provided at all. The reserve is in the system.

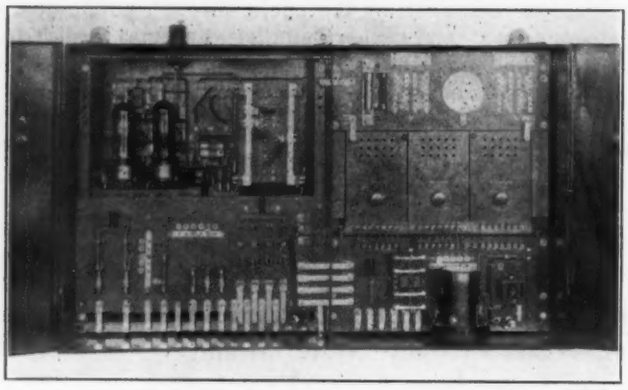
4. Interconnection of steam-electric stations or a combination of steam and hydro-electric stations enables a considerable saving to be made in fuel. In the case of exclusive steam plants the most efficient stations may be operated at maximum load factors while the less efficient plants need be called into service only when required.

5. Interconnection makes possible a greater utilization of an investment by providing load for equipment before the local market can absorb it. This condition is subject to change. One year one system may have surplus power for sale because of the installation of new equipment or the acquisition of a new source of power supply, while the next year conditions may be reversed and the neighboring system may have a surplus.

The above are merely abstract enumerations of some of the advantages of interconnection. As practiced at present the interchange of power is practically limited to an interchange between companies owning the interconnected transmission lines. To be most effective interconnections must be made on a larger and grander scale so as to bring about a more flexible arrangement which will permit the interchange of power not only between adjoining companies or systems but between systems that may be interconnected through other systems. But even as they are, limited by the size of the tie lines or the transforming equipment at the junction point, the results amply warrant the practice.

It is obvious that a hydro-electric system with water passing over the dam for a considerable portion of the time should be interconnected with a steam-electric station so as to use all of the water available without wastage and permit a considerable saving in fuel on the part of the steam-electric system. The advantages in such cases are mutual and instances of this kind abound.

Radio Used Extensively in Power Service



A view of a late type of carrier current sending and receiving set for interstation communication

EXAMPLES OF INTERCONNECTION

Typical examples of interconnected systems predicated on actual practice are given herewith. While they do not show every possible combination, they portray different conditions and indicate the greater economies still available to those who will take the trouble to make a thorough investigation of the possibilities. The ultimate goal is a vast interconnected network stretching from border to border and from coast to coast. By means of such a system every water power in the country will be made available for development, huge steam stations become the rule, and the electric public utilities will reach their highest productive efficiency coupled with maximum financial economy.

Case 1.—Two hydro-electric companies—A, operating two stations aggregating 11,000 kw., and B, operating three stations aggregating 19,000 kw.—have their power plants on the same stream. The load curves on the two systems differ considerably. They interconnect through a 6,000-kva. tie-in transformer. The load carried by the tie-in transformer since it was put in service four years ago has averaged 3,000 kva., representing water that would otherwise have gone to waste.

Case 2.—A 12,000-kw. steam-electric station, using fuel oil, interconnects with a 150,000-hp. hydro-electric system through an 80-mile wooden-pole line costing $150,000. Since the tie-in has been effected more than 25,000,000-kw.-hr. of hydro-electric energy, or from 85 to 90 per cent of the energy requirements of the smaller company, is transmitted annually over the line at an approximate saving of 100,000 barrels of oil.

Case 3.—An 8,000-kw. hydro-electric station on a stream possessing a fairly constant flow but with no facilities for pondage is tied in with the steam-reserve station rated at 5,000-kw. During approximately 100 hours of the year the load on the system is 13,000 kw. At night the load drops off to 2,000 kw. and during the day it hovers around 10,000 kw. As normally operated the company uses its steam plant only as needed to supplement the hydro-electric supply. Therefore the wastage of water during the night is considerable. Not far distant is an 80,000-kw. steam station which is fully loaded at the winter peak. An interconnection between the two systems was effected whereby the first system is enabled to shut down its steam station all summer and the second system not only supplies most of the power which the first system was heretofore compelled to generate in its own steam station, but in addition is enabled to shut down its own less efficient turbines during the time when the first system has water power to spare. When load conditions warrant, the second system sells all the surplus energy available. By means of the interconnection the second system is enabled to make a saving of 4 mills on every kilowatt-hour it receives from the first system during the night, and inasmuch as it cost the first system more than 1 cent a kilowatt-hour to generate energy in its steam plant, the energy which it receives from the second system to replace that which it would have to generate itself in this plant enables it to make a saving of approximately 1 cent a kilowatt-hour.

Case 4.—A hydro-electric system has a 5,000-kw. steam-reserve station at one end of its line which is called on to produce about 20,000,000 kw.-hr. yearly. In the same district is another hydro-electric system operating at a different frequency but with ample capacity and water storage. Interconnection was effected between the two systems through a 5,000-kw. frequency changer, since which time the steam station has been completely shut down, effecting a saving of more than 92,000 barrels of oil a year.

Case 5.—Company A has a 95,000-kw. steam plant and a peak load of 95,000 kw. Company B has waterpower varying with the season. During low-water periods it can generate 500,000 kw.-hr. a day; during high-water periods there is available water for approximately 5,000,000 kw.-hr. a day. Its peak is 50,000 kw. and hydro-electric equipment of that rating is installed. Interconnection between the two systems was effected, and as part of the agreement com-

pany B doubled the capacity of its hydro-electric equipment. Normal operation under the interconnection arrangement is as follows: Company B doubled its business with no increase in its fixed charges except for the waterwheels and generators. During low water it shuts down its entire system at night and stores the water. While its station is shut down it purchases all of its energy from company A. When, however, company A's peak load comes on, company B carries its own peak, the stored water enabling this to be done; but when the peak is passed company B takes energy again from company A and stores water until the peak of the next day. During the high-water periods company B carries its own peak load and also its night load and in addition sells company A energy at night and at any other time except the peak from water which would otherwise pass over the dam.

Case 6.—A gas and electric company has an output of 9,000,000 kw.-hr. a year, which is generated in a steam station requiring 4.5 lb. of coal per kilowatt-hour. Interconnection was effected with a large system possessing seven hydro-electric and two steam stations. The gas and electric company was thereby enabled to shut down its steam station and take all its energy from the larger system. The latter supplies most of the energy from hydro-electric sources and about 10 per cent from its steam stations, which, however, generate a kilowatt-hour on less than 2 lb. of coal.

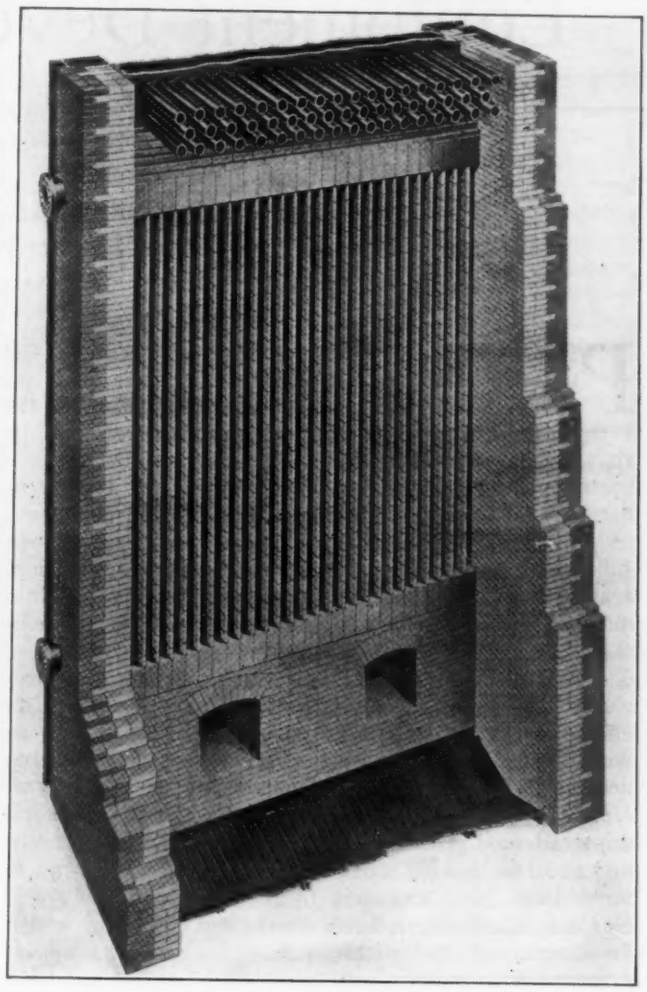
Case 7.—Four transmission systems serve as many states and all possess hydro-electric and steam stations which are interconnected. In this system, aggregating 1,000,000 hp., all available waterpower at any point is fully utilized before steam is called upon and the water power itself is operated at an efficiency wholly impossible before the interconnections were effected. Excessive drought caused system A to seek every available source of supply, and system D, 700 miles distant, was the only one having any reserve capacity. The excess in system D was therefore transferred to the lines of system C, which in turn furnished an equivalent amount of energy to system B, and system B transmitted a similar amount to system A, thereby relieving the shortage. In the territory served by system D is a large modern steam turbine station rated at 60,000 kw. This station, which was built as a part of a war industry, was normally idle. Anticipating a shortage in its own supply, system D, assisted by systems B and A, underwrote a lease on the 60,000-kw. plant, which was held in reserve for the entire section. The station can be put into operation on a few hours' notice and has carried loads as high as 30,000 kw. during extended periods of drought.

Case 8.—A study of the loads of three independent steam-electric systems in one of the most populous centers of the country indicates a diversity in excess of 12 per cent. The total load on the three systems approximates 1,000,000 kw. Through a diversity which interconnection would make available 100,000 kw. in installed generating capacity could be saved, in addition to 75,000 kw. in emergency reserve requirements. Thus interconnection between these systems would result in an increase of effective generating capacity of 175,000 kw., corresponding to an investment approximating $20,000,000. That sum is more than would be required to build the necessary tie lines, including the step-up and step-down transformer stations.

Case 9.—Company A has an installation of 100,000 kw. in modern turbines and its cost for coal and labor approximates 8 mills. Company B has an installation of 50,000 kw. in modern steam turbines and its cost for coal and labor is 9 mills. Company C has a 5,000-kw. reciprocating engine and its cost for coal is 1 cent per kilowatt-hour and labor amounts to $50 per shift. Between stations B and C there is a 3,000-kw. line, and another tie line of similar capacity connects stations A and C. The operations are as follows: During the summer company C shuts down, taking all of its load up to the capacity of the tie line from company B and whatever else is necessary during the summer peak from company A. During the winter company C takes its light load from company B, but starts up once a day and carries the whole of its own peak. Recently company A installed a new turbine capable of taking care of two years' growth. This has enabled company C to run with only a part of its reciprocating equipment during the winter peak, and during part of the winter, owing to spare capacity on the systems of A and B, station C was able to shut down for a month.

Case 10.—A hydro-electric system possessing three waterpower plants is so situated as to be able to operate at full capacity all the year round with no steam reserve. Having 8,000 kw. to spare, a 35-mile line was built to supply a much larger system possessing both hydro-electric and steam-reserve stations. As much as 51,000,000 kw.-hr. has been transmitted over this interconnection in a year, thereby relieving the auxiliary steam plants of the larger system of that amount of load and saving 230,000 barrels of oil.

Furnaces and Boilers Improved



A more complete knowledge of combustion and the increased prices of fuel have aided the development of furnaces and boilers. View of a radiant type of superheater exposed to the direct heat of the fuel bed.

LIMITATIONS TO ECONOMIES EFFECTED

It will, of course, be appreciated that in all of the examples cited the actual savings were not so great as indicated, as maintenance and fixed charges on the transmission and some differences in plant costs other than fuel must be deducted before the net economic result is obtained. Examples may be cited of still more intricate interconnected systems and of the additional savings which have been made possible where the operation of the various systems is centered in one system operator.

Involved in all interconnections of this kind is the question of rates. Obviously the price of interchange energy must never be such as to impose on the purchaser a greater burden than he would have to carry with the use of his own power sources, nor should it be so low as not to yield a profit to the seller. The major profit should go to the company exercising the maximum initiative whereby the economies through interchange have been made possible.

Equipment Development in 1922

By Allen M. Perry
Engineering Editor ELECTRICAL WORLD

Tendency Toward Concentration of Generation and Transmission of Electrical Energy Has Forced Higher Rating and Reliability in Equipment—Improvements in Industrial Equipment Have Extended Applications

PRODUCTION and development of electrical and allied mechanical equipment have been very encouraging during the past year, according to the reports from a large number of manufacturers. While the design and construction of most equipment have been along established lines, with improvements only in details, there have been a number of major developments in apparatus during the past year which have been influenced by the tendency to concentrate generation, transmission and distribution of electrical energy into units of greater rating, higher voltage and higher efficiency to secure better economy.

Never before has there been such activity in hydro-electric development, and manufacturers have felt its effect in the demand for hydro-electric equipment as well as for the high-tension transmission apparatus necessitated by this development of water power. Unusual demand for heavy-duty oil circuit breakers, unprecedented production of transformers of all classes and record-breaking calls for outdoor electrical equipment have been reported by various manufacturers. Nor has illumination been overlooked. Streets which have remained inadequately lighted for years have been provided with modern equipment, and interest has been quite generally aroused in better school lighting.

It would be repetition to outline detailed changes in operating practice during the past twelve months, since this has been ably done throughout the year in articles prepared by men actively engaged in the industry. Therefore a phase of electrical development which has only incidentally been touched in such articles—namely, equipment development—will be described in this article.

To make the information as nearly complete as possible 250 of the leading manufacturers in electrical and allied mechanical fields were asked the following questions:

1. What new apparatus or equipment has been developed and placed on the market during the past year which will have marked influence on future engineering practice or will make possible greater reliability or economy of operation?
2. What engineering investigations have you made or are you conducting to determine ways of developing or modifying apparatus so that it will meet operating requirements more effectively?

Some of the manufacturers addressed failed to reply, but the information from about fifty companies is presented below under major classification heads. In reporting developments it will be attempted, as far as space permits, to refer to operating conditions which influenced the development, and also to point out the significance of what has been done.

Stokers and Furnaces.—While the use of pulverized coal did not originate in the past year, the tendency toward its adoption under central-station boilers increased considerably. Many large stations are now considering it seriously and some new stations will use it. Every one is pretty well convinced of the practicability of burning pulverized fuel and of the efficiencies obtained even with low-grade fuel, but there is still a dearth of actual data showing the fixed charges and the operating and maintenance expenses involved. The advent of pulverized coal has stimulated strong competition on the part of multiple-retort and traveling-grate stokers, which are still the mainstay of all central stations. Efficiencies are being obtained with low-grade Western fuel on forced-draft chain grates which are comparable with the performance of forced-draft stokers burning Eastern fuel. Brush-shifting alternating-current motors have been applied for stoker drive, but there is still opportunity to improve greatly the means of utilizing alternating current for such service.

Considerable attention is being given to boiler furnace construction which will conserve heat and reduce maintenance. Excellent results are reported with high-temperature furnace insulation in firebrick form which will withstand a pressure of 40 lb. per square inch at 1,900 deg. F. without shrinkage. Attention is also being given to the possible use of new materials that will reduce maintenance cost and increase operating efficiency. The value of air or water cooling as well as of high refractory bricks around the fuel and clinker line of furnace side walls is quite generally recognized. The development of low-pressure forced-draft stokers with liberal air space has been undertaken. New boiler and furnace designs have been developed during the past year in which particular consideration was given to fuel characteristics, furnace volume, excess-air requirements for complete combustion ahead of the tubes, etc. Curved or sectional walls have been employed to allow expansion, while brick roofs and side walls have been supported on girders to relieve the furnace walls of excess pressure. To allow greater gas velocities baffles have been rearranged and remarkable improvement has thus been achieved.

One of the most radical departures in furnace arrangement was made in the past year at one of the Detroit plants by placing thirteen retorts which are the equivalent of twenty-six ordinary retorts under type W Stirling boilers having 23,650 sq.ft. of heating surface apiece. The stokers have tuyères, grate bars and side walls that move parallel to the coal feed.

Boilers and Economizers.—Several manufacturers report having given serious consideration to the adaptation of boilers to higher steam pressures and temperatures. One company furnished some remarkable boilers designed for 350-lb. operation for the Waukegan plant, the superheaters being placed between two banks of

boiler tubes instead of in the last pass, as has been the practice before. Boilers for one of the Ohio plants of the American Gas & Electric Company will have to operate at 500 lb. pressure. The highest pressures for which boilers have been ordered is 600 lb.

In the design of boilers the radiant heating surface is being increased where possible. Double-deck construction is being used in central stations not employing economizers. Where economizers are used the pressure type are being provided consisting of modified boiler head sections having one pass and operating on the counter-flow principle with high-gas velocity. Radiant-type superheaters and steel-tube cast-iron shell economizers have come into more prominence during the last year.

The establishment and maintenance of a heat balance is being given more attention, an automatic method for performing this function having been developed which is applicable to duplex-driven auxiliaries and is actuated by the feed-water temperature. The load is automatically divided between the motor and turbine drive.

Turbo-Generators and Auxiliaries.—Elimination of causes of past turbine trouble, the development of record-breaking sizes, provision for bleeder or mixed pressure operation and acceptance of orders for turbines operable at the high steam pressures previously mentioned are the outstanding features of turbine development during the past year. The difficulties experienced with buckets and wheels due to axial vibration and the approximate coincidence of four-node and six-node critical speeds with the operating speeds have been carefully studied and have been overcome. Among other improvements which have been made are the provision of removable and replaceable low-pressure nozzles, improvement of nozzle partitions, provision of steam-sealed labyrinths with non-corrodible teeth, the use of cast-steel valve casings and turbine heads for temperatures of 450 deg. F. and greater, the elimination of vertical joints in high-pressure casings, and the redesign of emergency governors which permits testing them without disconnecting the generator from the line.

Another large turbine manufacturer reports that it has prevented leakage of steam past the turbine blades by new type of shroud ring and has avoided excessive blade lengths by low-pressure bleeding. Multiple-stage bleeding is coming into greater use for feed-water heating even in the smaller size units, a new line of bleeder or mixed-pressure condensing turbines having been developed for ratings of 500 kw. to 3,500 kw., 3,600 r.p.m.

The most remarkable steam turbines for rating are the single-case units being constructed for the Brooklyn Edison Company, which are rated at 62,500 kva. The 35,000-kw. base-load turbines which are being built for the American Gas & Electric Company to operate at 500 lb. pressure and 725 deg. F. are unapproached by any other turbines on order so far as pressure and temperature are concerned.

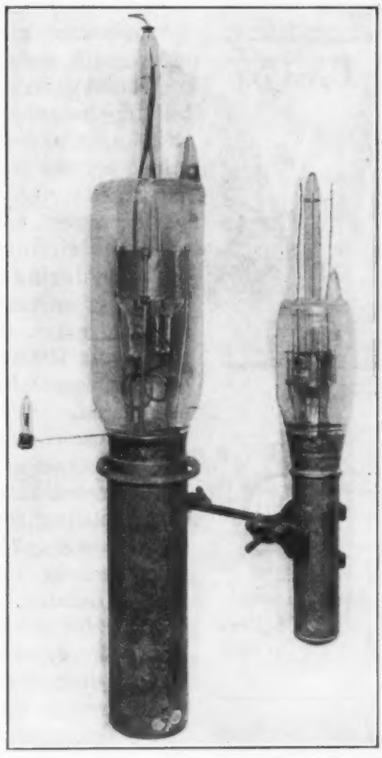
As mentioned previously, water-power development has been more active during the past year than ever before, one manufacturer alone having had three-quarters of a million horsepower of water turbines under construction or on contract at one time. One outstanding development of the past year is the turbo-type impulse wheel for heads of 800 ft. to 1,000 ft. Most of the innovations in hydro-electric development, however, like high-head reaction wheels, propeller-type wheels, submerged wheels, new developments in draft tubes, siphon type spillways, etc., were made more than a year ago; but numerous improvements have been made therein during the past year, and the apparatus has found application which proves the value of these developments. For example, practically continuous operation for eighteen months of the 25,000-hp. vertical reaction turbine at Kern River No. 3 under a head of 810 ft. has successfully demonstrated the practicability of this type of turbine. This is further evidenced by the fact that the Portland Railway, Light & Power Company has recently ordered a 35,000-hp. Francis-type turbine which will operate under a head of 850 ft. The Caribou development, involving 32,500-hp. turbines operating under 1,008 ft., has been in operation one year, and at least two projects are under development with heads exceeding 1,200 ft.—both in California, one on the American River, the other on San Gorgonio Creek. The 28,000-hp. water turbines for the Manitoba Power Company are remarkable as the first installation of very large size of the new propeller-type of wheel, while the installation at Mitchell Dam, Alabama, will be unique because of its backwater suppressor.

For rating the 65,000-kva., 1,200-volt, 25-cycle water-wheel generators for the Niagara Falls Power Company have the record. These units have an auxiliary generator between the main unit and the exciter supplying auxiliary power and will be guaranteed to operate at 97.8 per cent efficiency at 90 per cent power factor, full load. An unusual application is being made for the Tallassee Power Company, involving a 31,250-kva., 60-cycle, 13,200-volt generator which will be placed on top of an existing 18,000-kva., 30-cycle generator, all to be driven from one waterwheel, to supply separate sources of electric power or serve as frequency changers.

Various applications of automatic control to small hydro-electric plants containing synchronous equipment have been made. This seems to be one means whereby small remote hydro-electric power can be developed economically and interconnected with existing systems.

Improved grades of sheet steel for generator armatures have been developed, one company announcing that a new steel has been developed which reduces iron losses 25 per cent. Improved forms of ventilation at high speeds are also reported by this company and another.

Vacuum Tubes for Power Applications

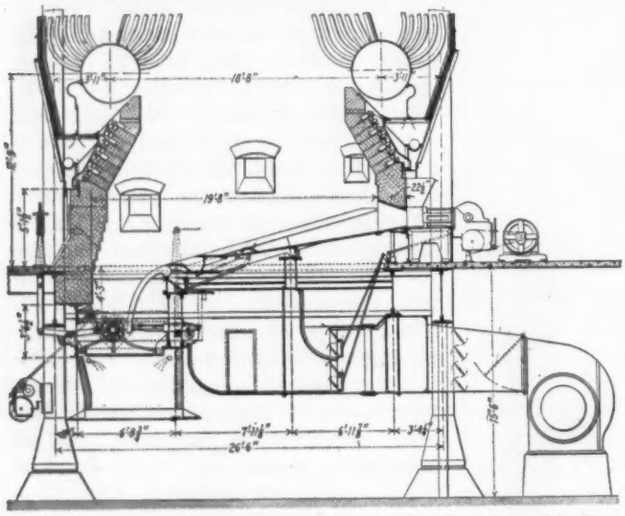


The year has witnessed the development of a 1,000-kw. power tube. View of a 100-kw. power tube recently produced.

Owing to the large volume of air needed for ventilating large steam turbo-generators and the necessity of reducing fire hazards, closed-circuit ventilation has gained in popularity. For use with this system a modified form of air washer and cooler has been developed during the past year and inert gases have been introduced for smothering fires.

Switching and Protection.—According to the reports received from manufacturers, there was an unusual amount of development in oil circuit breakers, relays, instrument transformers, reactors, lightning arresters, disconnecting switches and air and oil-break switches for outdoor use. Greater ruggedness and better design of contact mechanisms made marked changes for the better. Isolation of phases and electrical and mechanical interlocking of disconnecting switches and circuit breakers was extended in the year, at least in stations of the larger size. No definite opinions have been expressed yet regarding the minimum size of station in which phase isolation and interlocking can be economically applied, nor has a definite decision been reached on vertical versus horizontal phase isolation. As mentioned previously, the developments have been influenced chiefly by the tendency to concentrate energy production and transmission and to obtain more reliable service.

Bigger Boilers and Furnaces Used



The year has witnessed an increase in the size of boilers and volume of combustion chamber. A section of furnace and stoker for type W Stirling boilers.

Circuit Breakers.—Circuit breakers rated at 220,000 volts are in service, and extensive tests have been conducted on electric service systems which afford data to enable intelligent modification of circuit breakers which will adapt them to more severe duty. At present there seems to be some delay in coming to a decision regarding the number of "shots" for which circuit breakers shall be rated, but it is hoped that the differences of opinion will be removed soon. Considerable attention is being given to the rupturing capacity of oil circuit breakers, one manufacturer reporting circuit breakers which have resilient tanks, oil separators, four-break contacts, inverted brushes and vertically laminated bridge arms to facilitate alignment and contact. This company is also investigating the value of eight breaks in series, arcing tips, operation at higher speed and the ejection of gases caused during rupturing. Truck-type switchboards are becoming more popular and a new unit-type switchboard is announced which possesses nearly all the merits of the truck board and some others.

Relays.—There is a greater tendency to relieve operators of functions which relays and automatic control equipment can perform better. For example, a thermal relay with two operating points has been developed to reduce the number of shutdowns from overload by automatically changing the load-limit setting. When the first limit is reached the second limit is automatically established; when this is reached the relay operates to shut down the equipment. The same company has developed a field relay and a field-building relay, an overload-discriminating device and an improved mechanism for operating circuit breakers. The field relay is provided with a copper damper to prevent drop-out with momentary reduction in the field current. The field-building relay permits rapid building up of the field by shorting a part of the field resistance until a predetermined voltage is attained. Overload discrimination has been made possible by using an inductive shunt which sends current through a bucking bar that operates to open the circuit breaker when the rise of current is rapid, as during short circuits. The new circuit-breaker, operating mechanism utilizes the stored energy of a rotating mass, thereby reducing the amount of power required. It is particularly applicable to reclosing circuit breakers which must function a number of times in succession.

For automatic station operation another manufacturer has developed a polarity-directional relay, an induction over-current relay with auxiliary current scale and a sectionalizing relay of the impedance or distance type.

Instrument Transformers and Regulators.—Several developments in instrument transformers have been made, notably a heavy-current through-type transformer for 300 amp. to 2,500 amp., interchangeable high-side, dry-type current and potential transformers and oil-immersed weatherproof current and potential transformers up to 300 amp. for pole mounting, and a two-stage current transformer with a one-turn primary. The latter is asserted to be indestructible by short circuits, and its accuracy is equal to that of the best multi-turn type.

For close regulation of voltage an induction-type regulator has been developed with a new magnetic type of brake which is noiseless and quick-acting.

Reactors.—Causes of reactor trouble have been studied very carefully during the past year with a view to ascertaining the remedies, and the results have been very satisfactory. Thermal and mechanical stresses during short circuit are well under control despite the fact that electromagnetic stresses may reach 700 tons. Some small, rugged, efficient, semi-porcelain-clad reactors have been developed with generous conductor cross-sections and better ventilation which have withstood rain tests at 28,400 volts. Single-phase and three-phase feeder reactors have also been improved and developed. The protecting value of reactors in extensive electric service systems seems to be firmly established, and even smaller companies are using them without materially affecting the regulation, losses or power factor.

Supervisory Control.—With a tendency toward automatic generating stations and substations and the necessity for system operators to keep closely in touch with conditions over the entire system has come the development of two types of supervising control. One, the selector type, is for use where few operations per

station are required and the system is extensive. It utilizes three telephone wires between stations. Impulses sent out from the system operator's office operate selectors in the remote station and in turn perform specific operations which are reported by means of red or green signal lamps through the medium of auxiliary switches. The second type, known as the distributor system, is employed within a radius of 20 miles of the central office and where a large number of operations is involved. Distributors in each one of the stations as well as the central office operate in synchronism, giving positive or negative impulses that operate relays and auxiliary switches on the apparatus controlled. Operation is reported by auxiliary switches actuating the distributors. Four wires are essential between stations.

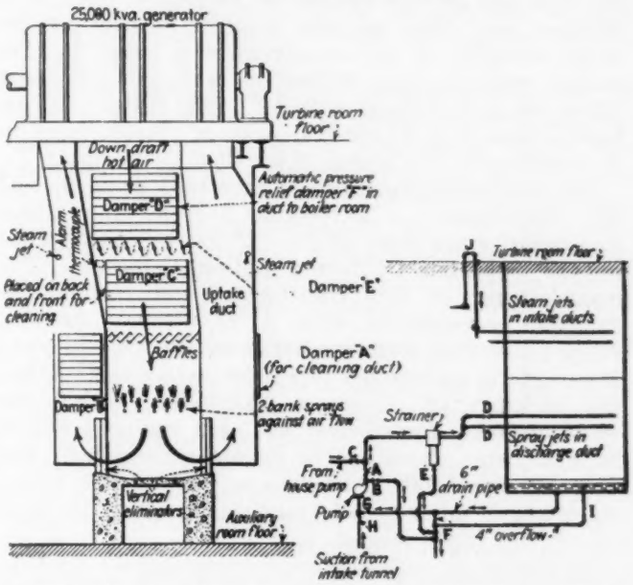
Outdoor Switches.—Developments in outdoor switching equipment consisted chiefly of improved air-break and disconnecting-switch construction, with remote operating mechanisms therefor. A combined oil-and-air-break switch has been developed for outdoor use on light loads which is capable of breaking the charging current of long lines. Failure of the oil pot would not ground the circuit, it is claimed. Some of these switches are being used on the Pacific Gas & Electric Company's lines. Another novel liquid-break switch for pole-top mounting has been developed the contactor of which is operated by tilting the container. Some units of this type are in service in the Middle West. The manufacturer has also developed an improved three-phase, vertical-break, double-throw air-break switch with self-aligning contacts, arcing rollers and sleet hoods. The entire switch is a unit instead of being made up of sections. Besides this an outdoor fused disconnecting switch in which the fuse is bridged by a porcelain tube has been developed. Another group-operated outdoor disconnecting switch, the three elements of which can be mounted one above the other in a vertical plane and interlocked with the oil circuit breaker if desired, has been developed for ratings up to 800 amp. and 150 kv. The manufacturer has also developed an outdoor grounding switch which can be operated by remote control if desired. Remote control mechanisms, operable on alternating current or direct current, are available with overload tripping devices if desired. Another motor-operated mechanism for high-tension disconnecting and air-break switches, suitable for remote control, is also available. "Disconnects" with only two insulators per phase instead of three have been marketed. The expulsion-fuse type disconnecting switch is available for ratings up to 7,500 volts and 200 amp. and is capable of rupturing 2,000 amp. The manufacturer claims that these switches have functioned satisfactorily up to 20,000 kva.

Expulsion fuses for 66-kv. circuits and air-break switches for 100 kva. and above are available.

Lightning Arresters.—Only one distinctly new type of arrester has been reported this year, namely, the "auto-valve," which requires no charging. Where used for protection of distribution transformers it has been so successful that it is being extended to station protection. Operating data should now be available on the oxide-film type of arrester. The compensated-disk gap and flash-rod types of lightning arresters reported last January have been applied during the past year. The demand for the former has extended to the lower-voltage field. Three new designs have been made, one for 600-volt direct-current service, one for 2,300-volt service and one for steam-railway signal circuits.

Line Supports and Insulators.—The large amount of high-tension transmission and interconnection undertaken during the past year and the effect of the severe sleet storm in New England a year ago have enlarged the circle of interest in the design of line supports. The question has arisen in various quarters whether tower-design practices will have to be revised in so far as stiffness formulas, safety factors and assumptions of broken wires are involved. In general it is not believed that it is economical to design towers which will stand such severe sleet storms as the one last year unless a weak link is placed somewhere between the line support and the conductor itself to relieve the stress under abnormal conditions. The relative values of painting and galvanizing are again up for reconsideration. A manufacturer of expanded steel poles announces that larger sections are available for heavier loading and that precast foundations and easily attachable arm fixtures can be provided.

Closed-Circuit Ventilation



The inclosed system of ventilation is extending and the year has witnessed the introduction of air washers and also the use of inert gases for fire-extinguishing purposes.

The most notable high-tension lines undertaken during the last year are those of the Southern California Edison, the Pacific Gas & Electric and Great Western Power Companies. The first two will operate at 220 kv. and the latter at 165 kv. The construction which facilitates these supervoltages is being rapidly completed.

While there was apparently considerable investigation of the insulator problem during the past year, very little is reported by manufacturers. In general standard disks of extra large diameter and strength are being used on a supervoltage line, sometimes with grading shields or high-capacity disks next to the line. No radical innovations have been made in insulators, the chief development being refinement in details of design and manufacture. Drop-forged caps have been adopted for 10,000-lb. and 18,000-lb. standard and heavy-strength units, the 18,000 lb. units being provided with heat-treated vanadium-steel connecting pins. Insulators with this improvement are being used extensively on the largest systems, including 220,000 volts. The manufacturer reports it is using the vacuum process of producing in-

sulator clay to eliminate air content, to secure greater homogeneity and to increase the possibility of making a greater variety of shapes. Gratifying results have been reported with link-type insulators.

In the past there have been a great variety of insulator test methods favored by operating companies. Recently several companies which have used the 60-cycle flashover or high-frequency tests have adopted the over-potential test. Various studies of insulator deterioration are being made including the effect of weathering.

Transformers.—Unprecedented production of all classes of transformers took place during the past year, more transformers of 10,000 kva. and higher ratings being ordered and constructed than during all the preceding years combined. The most recent development has been to leave some space over the oil in the top of the tank and provide means for keeping it filled with nitrogen gas. This not only prevents oil fires but reduces oxidation of the oil, serves as a buffer in case sudden pressures occur within the tank, and also saves filling the tank entirely with oil. This feature will be incorporated in a 25,000-kva. bank of transformers to be furnished to the Middle West Utilities Company.

The ratings of transformers have been going up and up. For example, a 36,700-kva, 50-cycle, single-phase auto-transformer rated at 150/220 kv. will be installed by the Southern California Edison Company. The manufacturer of this transformer will furnish the Japanese government with a 21,000-kva., 50-cycle, single-phase transformer rated at 66/150 kv. To make it possible to tie together two 50-kv. systems and adjust the exchange of energy, a 15,000-kva., three-phase 48-64/48-60-kv. transformer has been equipped with a ratio adjuster which can be remotely controlled. For dimensions probably the 20,000-kva., 50 cycle, 220/72-kv., single-phase water-cooled transformer which is being constructed is the largest.

To remove objectionable triple harmonics a 5,550-kva., 50-cycle auto-transformer rated at 220 kv.Y/150 kv.Y has been constructed for the Southern California Edison Company with a tertiary winding. It will be used to interconnect lines on which no lightning arresters are installed. The Southern Power Company will install an 18,750-kva., 60-cycle, 102/66-kv., three-phase transformer which will have a continuous rating of 25,000 kva. A rather unique transformer having three windings for simultaneous operation has been constructed which is rated at 12,000 kva., 60 cycles, 44-13.6/23-40-kv., three phase, with 50 per cent overload for two hours. One of the windings is rated at 12,000 kva. at 44 kv., another at 8,000 kva. at 13.6 kv., and the third at 4,000 kva. at 4 kv. The manufacturer announces that ratio adjusters are being applied to larger-size transformers, these devices having been standardized for currents up to 500 amp. and modified for 1,250 amp. at 13.2 kv. and for 2,200 amp. at 150 kv. One-million-volt testing equipments have been constructed for test purposes. One of the sets, consisting of four 250-kva., 250-kv. transformers, has been built for the California Institute of Technology.

To facilitate the cooling of transformers where water is scarce forced-draft radiators have been developed on which low-pressure air jets can be directed. The manufacturer has also developed an indicating and signaling flow device for water-cooled transformers which is positive, simple and strong in action, utilizing the Venturi-tube principle to actuate a rubber diaphragm. This company is also manufacturing a portable electrically heated centrifugal oil drying and purifying outfit and has extended the use of welded tanks to distribution transformers of 10 kva. to 100 kva. rating.

While pressed-metal tanks are not new, one manufacturer has announced that they are being employed for all distribution transformers.

Substations.—In the substation field the major development has been the application of automatic control to alternating-current feeders. Kansas City furnishes a good example of such a station having two or more incoming feeders with two or more banks of transformers and the usual number of outgoing feeders, all automatically controlled. In three-wire motor-generator substations the latest development is the application of automatic control for cutting in a differential field to protect the sets during overload. Automatic control has also been extensively applied in the coal mines, and notably by the Star Coal & Coke Company, where two unit motor-generators are installed with reclosing circuit breakers on the feeders. Among other examples of the application of automatic control is the installation of the Penn Public Service Company, where automatically controlled 5,000-kva. synchronous condensers are in successful operation.

New Automatic Equipment Produced

In applying automatic control to substations many automatic features which have been made a part of modern manually operated stations have been incorporated, but new devices have had to be developed also. Among them are direct-current and alternating-current reclosing circuit breakers and slip relays of the balanced type. The latter will perform the switching operation when a synchronous motor pulls out of step. The high-reluctance commutating-pole 60-cycle converter is an accomplishment of the past year. It incorporates flash barriers and a new design of brush holder which covers only a small portion of the commutator periphery, reduces flashing and makes the brushes readily accessible. The adjustable notching relay which functions after a predetermined number of operations is another development which has enabled automatic control.

Among other pieces of apparatus which have been developed for substation use and are particularly interesting are some synchronous condensers with two ratings—namely, 30,000 kva., 7,920 volts, 60 cycles, 600 r.p.m., or 25,000 kva., 6,600 volts, 50 cycles, 500 r.p.m.—for the Department of Public Service of Los Angeles. There are also the 30,000-kva., 6,600-volt, 50-cycle, 600-r.p.m. synchronous condensers for the Southern California Edison Company, the 35,000-kva frequency changers for the Brooklyn Edison Company, the 20,000-kva. synchronous condensers for the Pacific Gas & Electric Company, and synchronous motors for 100 and 80 per cent power factor in sizes of 50 hp. to 2,000 hp. and with speeds of 327 r.p.m. to 1,800 r.p.m. Sturdy static condensers have also been developed in power sizes.

A new automatic series cut-out for street-lighting circuits has been developed which is simple, requires no adjustment and involves carbon gaps and solenoid-operated contacts.

Meters.—Considerable attention has been devoted to demand meters during the past year, one for measuring kva. demand comprising two polyphase elements geared so that the energy component actuates the stylus while the reactive component controls the motion of the chart. Another is composed of ordinary watt-hour meter elements, one set of which is operated proportional to

the kilowatt-hours and the other proportional to the kilovolt-ampere-hours. The shafts operate a pantograph. The manufacturer has also perfected a remote indicating and recording instrument operated by impulses and utilizing ordinary telephone or telegraph wire for the connecting link. Distance will have no effect on its accuracy, it is claimed.

Watt-hour meters with bottom terminal chambers adapted to safety cabinets have been developed in 5, 10, 15 and 25-amp. sizes for two-wire and three-wire, 110-volt and 220-volt circuits. All have the same dimensions. The same company has developed a demand attachment for watt-hour meters to indicate the fifteen-minute demand and total kilowatt-hours consumed during any given period.

Illumination and Lighting.—Extensive investigations have been conducted during the past year on illumination matters, such as the extent of electric sign advertising, legibility of electric signs, overcoming daylight reflection in show windows, revision of motor vehicle headlamps to comply with legal requirements, the adequacy of street lighting, attracting power of show-window lighting, improvement in optical elements for motion-picture projectors, school lighting, and the effect of artificial light on plant growth. It has been found that only about 3½ watts is used for electric advertising per capita, or 5 kw.-hr. per year per capita. By using 1,000 foot-candles to 2,000 foot-candles for illuminating the inside of show windows the effect of daylight reflection can be overcome. The survey of street-lighting practice seems to indicate a tendency toward three to ten times the previously prevailing intensity. As regards the attracting power of light it was found that 40 foot-candles is 33 per cent more attractive than 15 foot-candles and 100 foot-candles is 75 per cent more attractive than 15 foot-candles.

Among the outstanding developments in the illumination field have been the "glassteel" diffuser, the 75-watt white diffusing-bulb, gas-filled incandescent lamp, the 1,000,000-lumen incandescent lamp, the 25,000-lumen gas-filled incandescent lamp for street lighting, the 250-watt concentrated-filament lamp for projection work, a new spray coating for coloring lamps, and improvements in luminous arc-lamp electrodes.

The "glassteel" diffuser is a modification of the RLM reflector. It has an enameled-steel reflector and a glass diffusing globe which together enable some light to be directed at the ceiling. It is adapted to clear gas-filled lamps, producing a brightness of only 2 cp. to 5 cp. per square inch with an efficiency of 65 per cent. It is made in two sizes—18 in. for 100, 150 and 200-watt lamps and 20 in. for 300-watt and 500-watt lamps.

The new spray coating for coloring lamps is practically permanent, cleanable and a good diffuser of light, thereby broadening the field of color lighting.

The new electrodes for luminous-arc lamps are compressed square or oval cross-sections, made in such a way as to increase the life and efficiency. Luminous-arc lamps are still being used extensively for the highest-class illumination, notably in Detroit, Salt Lake City, Buffalo, Toledo, Philadelphia and Pittsburgh.

White-way lighting is extending to business districts, residence streets, parks, boulevards, etc. The totally inclosed semi-indirect prismatic glassware for street lighting is a development of the past year which gives a smooth surface and sharp slope, preventing dust accumulation. The East Cleveland street lighting is a notable example of modern lighting. On residence streets 150-watt gas-filled lamps, staggered 250 ft. on centers, are used; on thoroughfares, 1,000-cp. gas-filled lamps are placed 280 ft. on centers. One-piece rippled-glass globes are used in baskets with porcelain-enameled reflectors and dome prismatic reflectors. On thoroughfares crystal glass is used and on residence streets opal glass. Lamps are fed in multiple from back-of-lot lines.

Electric Ovens and Furnaces.—A notable expansion has occurred during the past year in the use of electric heating devices for industrial processes, particularly in heat treating of metals, baking enamels and foundry cores. Small and medium-size ovens with 275 cu.ft. to 1,000 cu.ft. capacity for operation at 100 deg. F. have been developed, and furnaces have been built for baking vitreous enamel on bathtubs with absolute temperature control and freedom from gases and fumes. Electric ovens and low-temperature electric furnaces have also been extensively applied during the past year for melting non-ferrous metals, as well as for heat-treating ferrous metals.

In the higher-temperature furnace field a start has been made in applying large electric steel refining and superheating furnaces in conjunction with blast furnaces by using a Bessemer furnace between them. The possibilities with this combination deserve more study. There is also an opportunity for improvement in quality and saving in metal loss by considering the electric furnace in melting ferro alloys before they are added to the open-hearth furnace.

ELECTRICITY USED WITH BOILERS

Electric Steam Boilers.—Equipment for generating steam with electric power has aroused interest in various parts of the country, especially where fuel is scarce and surplus water power is available at a low rate. High-tension electric steam generators of the kind announced last January have been installed to the extent of 150,000 kw. in the past year and are operating at 99 per cent efficiency, according to the manufacturer. One big advantage of such boilers is their lower first cost compared with fuel-fired boilers and their flexibility and ease of control. Another electric steam generator has been developed which is also extremely simple, reliable, compact and high in efficiency. Its chief difference from those previously developed is a separation of the steam generating space from the hot well and the provision of adjustable circulation between the two which enables regulation for steam demand and energy input and facilitates forcing.

Welding Equipment.—A new constant-current set, a constant-potential set and two portable welding outfits are announced. The constant-current machine is now being tested, but the constant-potential machine, which is rated at 400 amp., is already available. The latter has three resistors (two for metallic and one carbon welding) which permit three separate or combined operations to be performed simultaneously. One portable welding set is driven by a gas engine, and the other is a semi-automatic set which allows the operator to direct the arc but still retains the continuous feed. The demand for more rapid deposition of metal in arc welding has influenced the use of larger metal electrodes and higher currents, namely, 300 amp. and larger.

Industrial Heating.—Electricity as a source of heat for industrial plants has also been employed during the last year, notably by the Canadian Cottons Company.

Motors and Control.—Several interesting motors and speed regulators have been developed, but the principal

progress has been made in perfecting the applications of motors and control apparatus to various industrial processes, among which are paper making, calendering, newspaper printing, metal rolling and reeling, woodworking, textile manufacturing, hoisting, refrigeration.

A synchronous motor with high starting torque and an induction motor with a rolled sheet copper rotor winding are two outstanding motor developments. Both the stator and the rotor of the synchronous motor can revolve. In starting, the stator is allowed to revolve, then the field is applied, and a band brake is gradually applied to the stator, thereby bringing the rotor up to speed. With this arrangement a starting torque equal to the pull-out torque of the motor can be obtained. The motor is economical of space, avoids clutches and extends the field of application of synchronous motors. The induction motor with the rolled sheet-copper rotor winding has a very high starting torque per ampere, owing to the skin effect of the rotor during starting. The open-slot construction employed does not appreciably increase the no-load current, and the zig-zag leakage is reduced.

A new line of induction motors which can be started on full-line voltage without a starting compensator or excessive starting current is available. The change in secondary resistance is automatic so that it is particularly adapted to push-button starting. Owing to the high-starting torque it can, according to the manufacturer, be selected for full-load running conditions instead of starting torque.

Ball-bearing, polyphase, squirrel-cage and slip-ring motors have been announced which have high power factor and operate silently even with a large number of poles. Another high-power-factor, constant-speed, high-torque motor has also been announced. Rugged construction is provided by an exceptionally large shaft and bearings and a dust-proof housing. The coils are wound in phase groups without connections and are impregnated with insulating compound. Adjustable connection blocks and pull boxes are provided which are adapted to either solid or flexible conduit. The fan blades and improved ventilating path give promise of low temperature operation. For machine-tool drives a multi-speed motor has been developed which has four separate windings.

The "thermaload" starter which was announced last year has been extended in use. Since it automatically resets itself after each tripping it is limited to use with momentary-contact switches, but it is now furnished with hand reset if desired.

For sectional drive where exact speed ratios must be maintained between individual-motor drives a direct-current motor-speed regulator has been developed which involves a mechanical differential attached to the two drives which must be kept in unison. A contactor is operated by the differential if there is any change in the speed ratio, and this actuates a vibrating-type relay which applies full corrective power for speed readjustment. Tests on this regulator, using 100-hp. motors, showed that correction for 100 per cent load change could be made in two seconds.

Paper.—Improvements have been made in sectional paper-mill drive and control by two companies which greatly simplify the drive and control and make it more effective in operation. One sectional paper-mill control involves a voltage regulator for each section so that any change in load speed will automatically and instantaneously apply full corrective power to the drive involved. For maintaining constant speed relationship between the various sections, dependence is placed on a synchronous motor tie-in with the main drive. Two contact disks are driven by the synchronous motor and the main drive respectively. These contacts rotate in the same direction, making and breaking contact at a rate depending on the angular displacement between the two disks. The making and breaking of the contact either short-circuits or inserts resistance into the direct-current motor field, thereby maintaining a fixed speed on the direct-current motor. Paper-calender drive and control has been perfected by utilizing a new commutator-type frequency changer to supply the motors when threading in the paper.

Full-automatic, direct-current control for large newspaper presses has also been developed which can operate three octuples, four sextuples, or four decuples and a quadruple. It has a simpler and more substantial pilot motor and pilot switch than formerly.

Steel Mills.—Improved control of cold-roll strip reels and rod reels have been reported. The first involves a generator driven by the last stand of rolls; this supplies power to the motor driving the reel. Across the field resistance of this motor is a voltage regulator controlled by the armature current. This combination maintains constant torque and consequently constant tension.

In the control of rod reels, an example of which exists at the Minnesota Steel Company's plant, a small alternating-current generator is driven by the main motor and another by the reel motor, the two driving a mechanical differential which operate a vibrating-type relay if their relative speeds change. This relay acts to increase or decrease the field on the reel motor.

Wood and Machine Tools.—In the woodworking and machine-tool fields there is a tendency toward using built-in direct-connected motors. To obtain the high speeds necessary induction frequency changers must be used in some cases. A wood molder having four motors for the cutting head and one four-speed motor for the feed has been developed. The head-drive motors are operated at 3,600 r.p.m. All five motors are controlled from one case, starting Y and running delta. Overload on any one motor will shut down all.

Hoisting.—Hoist and crane developments are reported by three manufacturers. One refers to a flywheel balancer set controlled by a current regulator which helps carry the peak loads during intermittent hoisting and stores energy between demands. This is being used by the Lehigh Valley Railroad at Jersey City. Where heavy-duty cycles are encountered in hoisting it is customary to use mill-type motors. Where hoist motors are liable to be abused the tendency is to use automatic control.

For general purposes unit-type portable hoists in half-ton and ton sizes are available for 25-ft. lifts at the rate of 25 ft. per minute. An improved crane brake is available which has interchangeable parts and easily adjustable brakeshoes.

Multi-voltage elevator control and micrometer leveling for passenger elevators has found increasing application during the past year.

Miscellaneous.—Among other remarkable electrical developments during the past year are the pallophotophone (or photographic recording and reproduction of sounds), carrier-current interstation communication, large electron valves, machine switching for telephone service, electric propulsion of ferryboats, and renewed interest in steam-railroad electrification, especially in foreign lands.

The World's Consumption of Electrical Energy

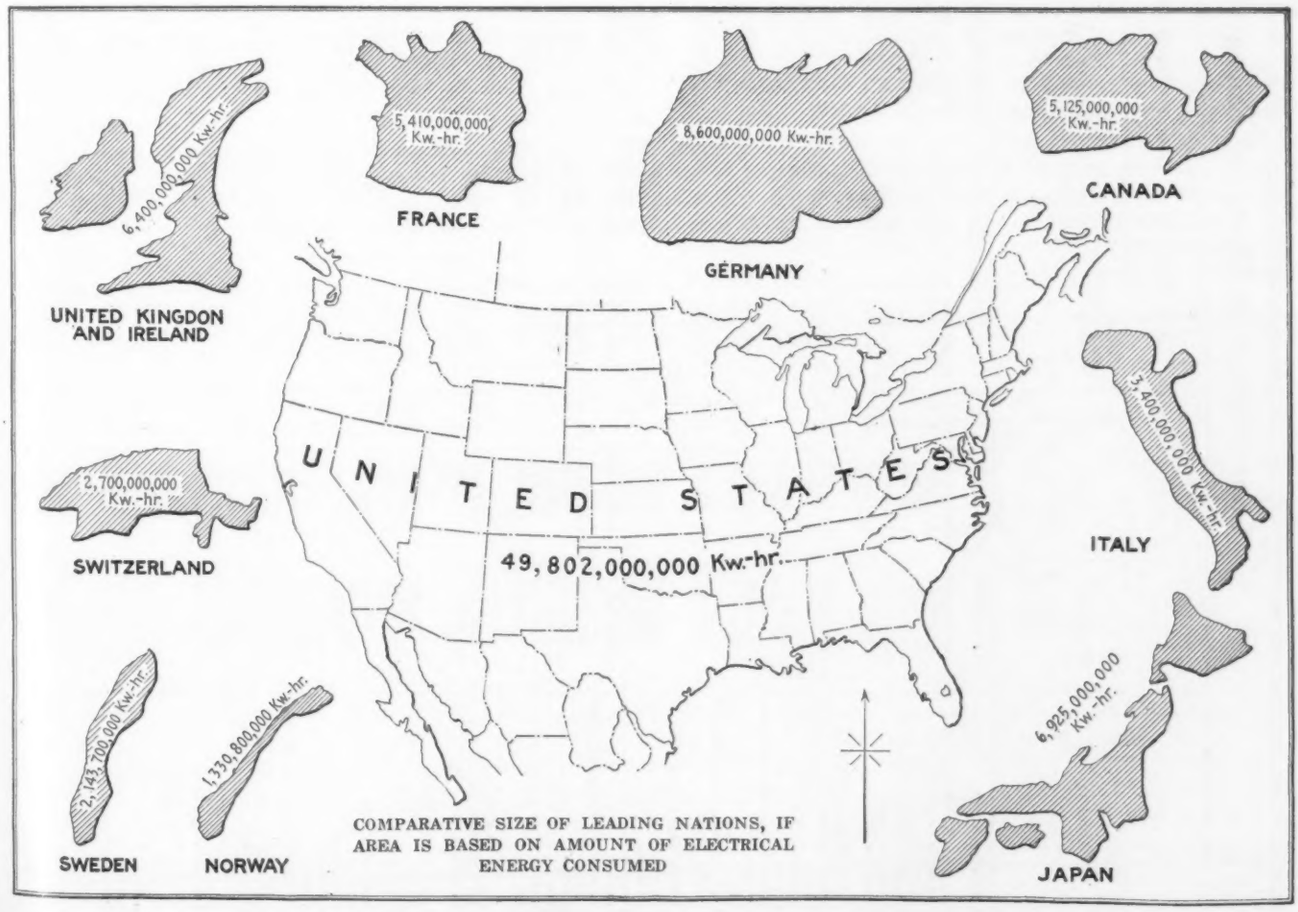
The United States Leads All Nations in Total Energy Consumption, but Switzerland Leads in the Consumption per Inhabitant—Total Generator Rating Placed at 46,427,690 Kw.

ELECTRICAL energy as a source of light, heat and power has woven itself into the domestic, business and commercial fabric of the world as few other forces of all time have done. From the frigid regions to the equator and from the Occident to the Orient nations are vying with each other in the electrification of their factories, mines and railroads and in the electric lighting of their homes. Peoples which are slow to adopt customs of other lands are adopting electrical energy with enthusiasm, until it may be stated with confidence that the central station bids fair to be the great equalizer of the world.

In an endeavor to ascertain the present status of the electrification of the nations in both hemispheres, the ELECTRICAL WORLD sent requests to the American diplomatic representatives in all foreign countries asking for certain data relative to the consumption of electrical energy in these countries for light and power during 1920. Foreign governments co-operated, and replies were received which made possible the presentation of the detail figures in the accompanying table. The world in 1920 consumed a total of 99,456,300,000 kw.-hr. of electrical energy, or at the rate of 57.8 kw.-hr. per inhabitant. Of this amount, 15,183,300,000 kw.-hr., or 15.3 per cent, was consumed for lighting purposes, and 84,273,000,000 kw.-hr., or 84.7 per cent, was used in the industrial activities of the world. It is probable that the energy generated by the steam and hydro-generating plants of the world totaled about 115,000,000,000 kw.-hr. during 1920.

It is estimated that of the 1,720,000,000 inhabitants of the world, only 111,822,000, or 6.5 per cent, are living in electrically lighted dwellings. There is estimated to be a total of 25,349,000 central-station customers, but it must be remembered that this does not in any way represent the total number of consumers of electrical energy, since there are many thousands of private plants making it for their owners' use.

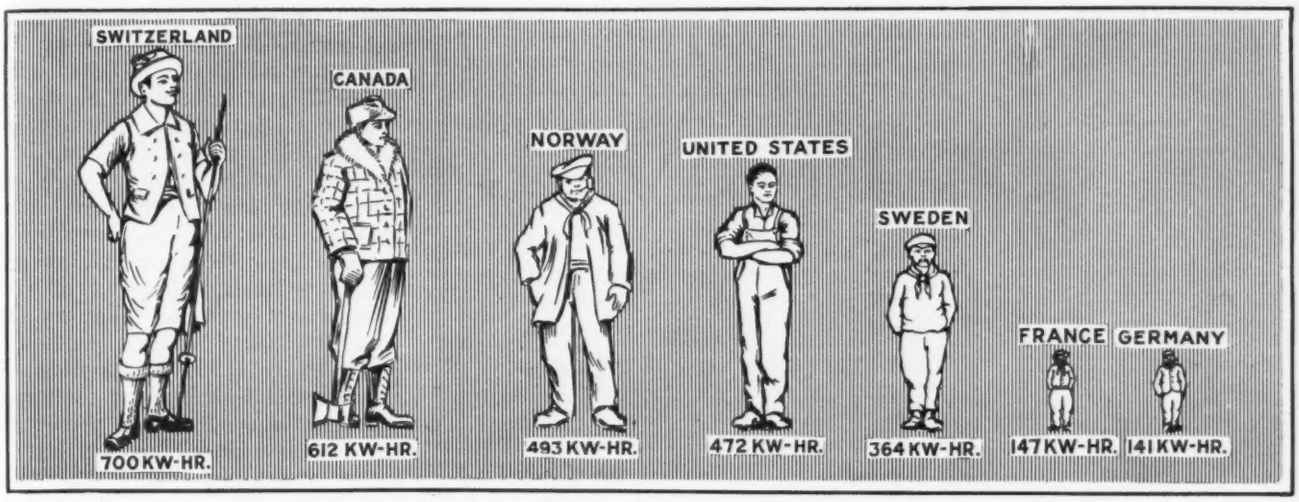
The huge output of electrical energy was made possible by an estimated generator installation of



COMPARATIVE SIZE OF LEADING NATIONS, IF AREA IS BASED ON AMOUNT OF ELECTRICAL ENERGY CONSUMED

Consumption of Electrical Energy by the Various Nations of the World

Country	Population	Dwellers in Electrically Lighted Abodes 1920		Total Number of Central-Station Customers	Electrical Energy Consumption				Water Power			Electric Generator Rating				
												Fuel-Burning Plants		Hydro-Electric Plants		
		Number	Per Cent of Total Population		Lighting, Kw.-Hr., 1920	Power or Power and Light, Kw.-Hr., 1920	Total Electrical Energy Consumed, Kw.-Hr., 1920	Kw.-Hr. Consumed, per Inhabitant	Potential (Minimum), Hp.	Developed Hp.	Per Cent of Total Developed	Rating, Kw.	Per Cent of Total	Rating, Kw.	Per Cent of Total	Total Generator Rating, Kw.
Totals for world	1,720,000,000	111,822,000	6.5	25,349,000	15,183,300,000	84,273,000,000	99,456,300,000	57.8	439,000,000	23,695,080	5.4	30,192,480	65.4	16,235,210	34.6	46,427,690
Totals for North America	145,000,000	43,065,000	29.7	10,608,000	7,536,100,000	47,776,700,000	55,312,800,000	382.2	62,000,000	12,866,380	20.8	18,941,000	70.4	7,969,000	29.6	26,910,000
Totals for South America	61,000,000	2,915,000	4.8	68 ,000	290,000,000	705,000,000	995,000,000	16.3	54,000,000	426,200	0.8	608,080	64.1	341,920	35.9	950,000
Totals for Africa	140,000,000	380,000	0.3	77,000	48,000,000	1,216,000,000	1,264,000,000	9.0	190,000,000	12,050	0.0	308,400	97.3	8,600	2.7	317,000
Totals for Europe	475,000,000	39,587,000	8.3	9,335,000	4,977,200,000	28,553,300,000	33,530,500,000	70.5	45,000,000	8,877,200	19.7	8,210,000	53.7	7,071,700	46.3	15,281,700
Totals for Asia	890,000,000	24,300,000	2.7	4,268,000	2,185,000,000	5,845,000,000	8,030,000,000	9.0	74,680,000	1,358,250	1.8	1,690,000	70.0	723,990	30.0	2,413,990
Totals for Oceania	9,000,000	1,575,000	17.5	378,000	147,000,000	177,000,000	324,000,000	36.0	13,320,000	155,000	0.1	435,000	78.3	120,000	21.7	555,000
NORTH AMERICA																
United States	105,766,000	39,000,000	36.8	9,598,000	6,870,000,000	42,932,000,000	49,802,000,000	472.0	30,500,000	9,540,000	31.3	18,406,000	76.3	5,724,000	23.7	24,130,000
Canada	8,370,000	3,200,000	38.3	800,000	581,000,000	4,544,000,000	5,125,000,000	612.0	20,000,000	2,755,980	13.8	250,000	11.9	1,850,000	88.1	2,100,000
Newfoundland	261,000	45,000	17.2	10,000	3,500,000	1,700,000	5,200,000	20.0	400,000	60,000	15.0	5,000	10.0	45,000	90.0	50,000
Mexico	16,767,000	320,000	1.9	80,000	32,000,000	237,000,000	269,000,000	16.0	6,000,000	450,000	7.5	100,000	25.0	300,000	75.0	400,000
Central America, including Panama	6,000,000	125,000	2.1	30,000	12,400,000	24,000,000	36,400,000	6.1	5,000,000	38,400	0.8	15,000	30.0	35,000	70.0	50,000
Cuba	2,900,000	300,000	10.4	75,000	29,700,000	23,000,000	52,700,000	33.0	.....	.....	....	150,000	100.0	0	0.0	150,000
West Indies, exclusive of Cuba	4,936,000	75,000	1.5	15,000	7,500,000	15,000,000	22,500,000	4.5	100,000	22,000	14.7	15,000	50.0	15,000	50.0	30,000
SOUTH AMERICA																
Colombia	5,475,000	125,000	2.3	25,000	13,000,000	16,000,000	29,000,000	5.3	4,000,000	25,000	0.6	30,000	60.0	20,000	40.0	50,000
Venezuela	2,848,000	75,000	2.9	15,000	7,000,000	11,000,000	18,000,000	6.3	3,000,000	12,500	0.4	21,000	70.0	9,000	30.0	30,000
Guianas	437,000	20,000	4.6	4,000	2,000,000	1,000,000	3,000,000	6.9	3,800,000	0	0.0	5,000	100.0	0	0.0	5,000
Brazil	30,491,000	1,000,000	3.3	200,000	99,000,000	47,000,000	146,000,000	4.8	25,400,000	250,000	1.0	50,000	20.0	200,000	80.0	250,000
Argentina; Paraguay and Uruguay	9,919,000	1,250,000	12.6	350,000	125,000,000	115,000,000	240,000,000	24.0	7,300,000	25,200	0.3	391,080	95.4	18,920	4.6	410,000
Bolivia	3,000,000	40,000	1.3	8,000	4,000,000	5,000,000	9,000,000	3.0	2,500,000	12,000	0.5	5,000	33.3	10,000	66.7	15,000
Chile	4,000,000	250,000	6.3	50,000	25,000,000	475,000,000	500,000,000	125.0	2,500,000	60,000	2.4	100,000	66.7	50,000	33.3	150,000
Ecuador	1,300,000	35,000	2.7	7,000	3,000,000	1,000,000	4,000,000	3.1	1,000,000	5,000	0.5	1,000	20.0	4,000	80.0	5,000
Peru	3,530,000	120,000	3.4	24,000	12,000,000	34,000,000	46,000,000	13.0	4,500,000	36,500	0.8	5,000	14.3	30,000	85.7	35,000
AFRICA																
Union of South Africa	6,000,000	345,000	5.8	70,000	34,000,000	.....	1,194,000,000	199.0	1,600,000	6,000	0.4	295,000	98.4	5,000	1.6	300,000
Miscellaneous	134,000,000	35,000	0.0	7,000	14,000,000	56,000,000	70,000,000	0.1	188,400,000	6,050	0.0	13,400	78.8	3,600	21.2	17,000
EUROPE																
Sweden	5,885,000	1,000,000	17.0	225,000	167,400,000	1,976,300,000	2,143,700,000	364.0	4,500,000	1,200,000	26.7	100,000	10.0	900,000	90.0	1,000,000
Norway	2,700,000	575,000	21.3	125,000	100,800,000	1,230,000,000	1,330,800,000	493.0	5,500,000	1,350,000	24.6	100,000	9.1	1,000,000	90.9	1,100,000
Finland	3,330,000	277,000	8.3	80,000	50,000,000	54,000,000	104,000,000	31.0	1,500,000	185,000	12.3	10,000	8.5	110,000	91.7	120,000
Czechoslovakia	14,000,000	1,400,000	10.0	350,000	190,000,000	105,000,000	295,000,000	21.0	2,600,000	125,000	4.8	105,000	58.3	75,000	41.7	180,000
Italy	40,000,000	4,500,000	11.3	1,000,000	612,000,000	2,788,000,000	3,400,000,000	85.0	3,800,000	1,150,000	30.3	400,000	28.6	1,000,000	71.4	1,400,000
Switzerland	3,860,000	1,000,000	25.9	225,000	200,000,000	2,500,000,000	2,700,000,000	700.0	1,400,000	1,070,000	76.5	100,000	10.0	900,000	90.0	1,000,000
Germany	60,900,000	8,810,000	14.5	2,035,000	1,100,000,000	7,500,000,000	8,600,000,000	141.0	1,350,000	1,000,000	74.2	2,600,000	81.3	800,000	18.7	3,400,000
France	36,700,000	5,000,000	13.6	1,250,000	652,000,0000	4,758,000,000	5,410,000,000	147.0	4,700,000	1,400,000	29.8	750,000	37.5	1,250,000	62.5	2,000,000
United Kingdom and Ireland	46,080,000	7,800,000	16.9	1,750,000	830,000,000	5,570,000,000	6,400,000,000	139.0	585,000	210,000	36.0	2,800,000	93.3	200,000	6.7	3,000,000
Belgium	7,600,000	1,500,000	19.7	325,000	240,000,000	500,000,000	740,000,000	97.0	small	700	....	600,000	99.9	500	0.1	600,500
Denmark and Iceland	3,362,000	1,000,000	29.8	205,000	67,000,000	123,000,000	190,000,000	57.0	500,000	1,500	0.3	100,000	98.9	1,200	1.1	101,200
Netherlands	6,600,000	925,000	14.0	190,000	78,000,000	265,000,000	343,000,000	52.0	0	0	....	200,000	100.0	0	0.0	200,000
Portugal	6,000,000	300,000	5.0	75,000	10,000,000	9,000,000	19,000,000	3.1	300,000	12,000	4.0	50,000	83.3	10,000	16.7	60,000
Spain	20,500,000	2,000,000	9.8	500,000	200,000,000	800,000,000	1,000,000,000	49.0	4,000,000	600,000	15.0	125,000	20.8	475,000	79.2	600,000
Miscellaneous	217,483,000	3,500,000	1.6	1,000,000	480,000,000	375,000,000	855,000,000	3.9	14,265,000	573,000	4.0	170,000	32.7	350,000	67.3	520,000
ASIA																
China	400,000,000	1,000,000	0.3	200,000	125,000,000	610,000,000	735,000,000	1.8	20,000,000	1,650	0.0	280,000	99.7	990	0.3	280,990
India	319,075,000	150,000	0.0	38,000	30,000,000	220,000,000	250,000,000	0.8	27,000,000	180,000	0.7	50,000	21.2	186,000	78.8	236,000
Japan	77,000,000	23,000,000	29.9	4,000,000	2,010,000,000	4,915,000,000	6,925,000,000	90.0	6,000,000	1,100,000	18.3	1,300,000	72.3	500,000	27.7	1,800,000
Miscellaneous	93,925,000	150,000	0.2	30,000	20,000,000	100,000,000	120,000,000	1.3	21,680,000	76,600	0.4	60,000	61.9	37,000	38.1	97,000
OCEANIA																
Australia	5,420,000	1,000,000	18.	250,000	100,000,000	160,000,000	260,000,000	48.0	620,000	60,000	9.7	400,000	89.0	50,000	11.1	450,000
New Zealand	1,218,000	375,000	30.8	80,000	38,000,000	6,000,000	44,000,000	36.0	3,800,000	60,000	1.6	25,000	33.3	50,000	66.7	75,000
Miscellaneous	2,362,000	200,000	8.5	148,000	9,000,000	11,000,000	20,000,000	8.5	8,900,000	35,000	0.4	10,000	33.3	20,000	66.7	30,000



SWITZERLAND LEADS IN CONSUMPTION OF ELECTRICAL ENERGY PER INHABITANT

46,427,690 kw., of which 30,192,480 kw., or 65.4 per cent, was operated by fuel power and 16,235,210 kw., or 34.6 per cent, was hydro-electric. The United States Geological Survey has estimated that the minimum potential water powers of the world total 439,008,000 hp., and it is estimated from the most recent data that only 23,695,080 hp., or 5.4 per cent of this great source of power, has been developed. It would seem that the production of hydro-electric energy is still in its infancy.

The consumption of electrical energy in the United States in 1920 was almost exactly equal to the consumption of all the remaining nations of the world combined. Including the energy generated in private generating plants, the United States consumed a total of 49,802,000,000 kw.-hr. during that year, of which 6,870,000,000 kw.-hr., or 13.8 per cent, was consumed for lighting purposes and 42,932,000,000 kw.-hr., or 86.2 per cent, was used in the factories and mines, on the farms and in the operation of the electric railways of the country. During the year 1922 it is probable that more than 55,000,000,000 kw.-hr. was consumed in the United States. Germany was second in electrical consumption, with 8,600,000,000 kw.-hr., if the various British commonwealths are taken separately.

While the United States far outstrips all other nations in total electrical energy consumption, the little republic of Switzerland easily leads in consumption per inhabitant, with 700 kw.-hr. Following in order come Canada, with 612 kw.-hr. per inhabitant; Norway, with 493 kw.-hr. and the United States with 472 kw.-hr.

Security Prices Advance During 1922

Electric Light and Power Security Issues Total $589,960,990 for the Year—Refunding Operations Were a Feature

IN PERIODS of disturbed business conditions there always arises a decidedly favorable attitude toward bonds of capably managed and conservatively capitalized organizations with stable earning power. Electric light and power companies generally fall within this class, and accordingly in the year 1922 there occurred a period of unprecedented activity in their financing. During the war and for more than two years following

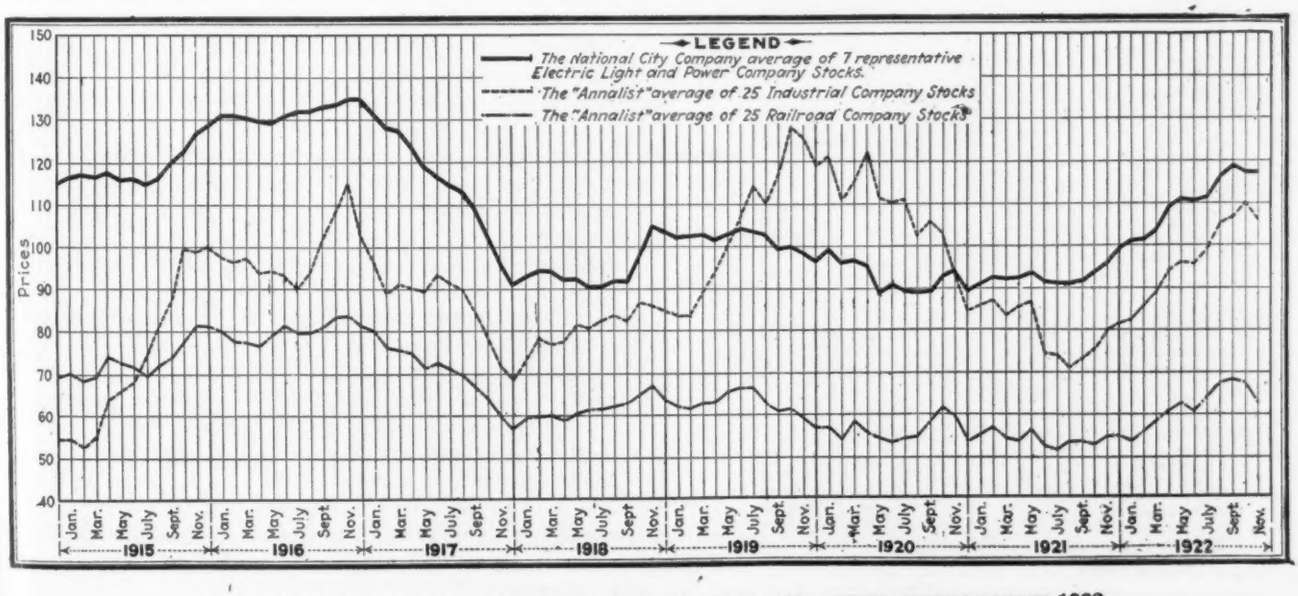


FIG. 1—MATERIAL INCREASE IN PRICE OF ELECTRIC LIGHT AND POWER STOCKS DURING 1922

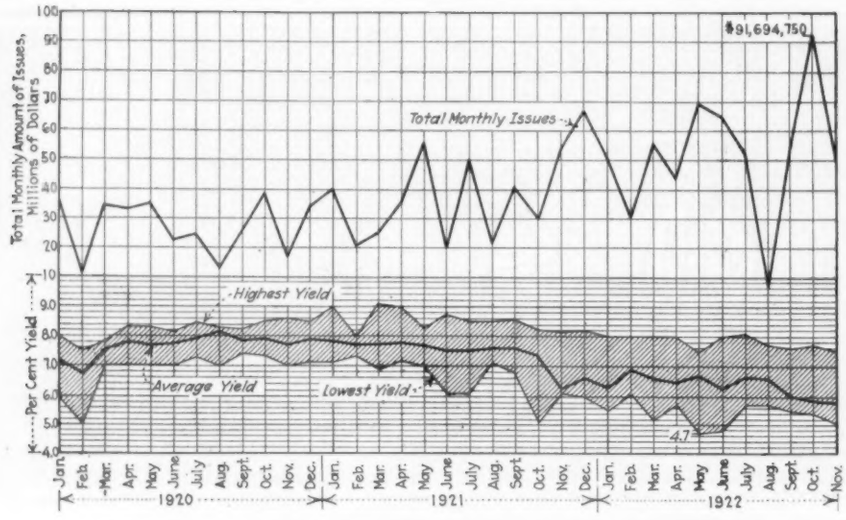


FIG. 2—MONTHLY ISSUES OF ELECTRIC LIGHT AND POWER SECURITIES, AND THE GRADUAL DECREASE IN YIELD

public utilities were hard hit by high operating costs and legal restrictions of rates. New legislation and recent court decisions, among the more notable of which was that handed down by the United States Supreme Court declaring New York State's eighty-cent gas law to be unconstitutional, have placed them on firmer ground and permitted in many cases rates that insure a reasonable return on invested capital.

Great improvement in the financial position of electric light and power companies throughout the United States in the past year attracted the attention of thoughtful investors, with the result that their securities were eagerly sought. Evidence of the increasing demand for and faith in public utility securities is seen in the fact that insurance companies, which invest millions of dollars every year for policy holders, have come to regard utility securities as a most desirable investment. This is a rather recent development—in years gone by the insurance companies invested their funds largely in railroad bonds and real-estate mortgages. Trustees and savings banks, when the state laws permit, are also coming more and more into the utility investment market. The fact that institutions such as these recognize the inherent soundness and desirability of such investments must be taken as significant of their intrinsic worth.

A feature of the year's financing of electric light and power companies was the unusually high percentage of new issues put out to refund called obligations which had been issued at a time when funds were costly. Corporations have been taking advantage of a comparatively easy money market to reduce their fixed charges by issuing new bonds bearing a lower coupon or by augmenting their capital stock largely through sales to their customers. A total of $80,587,290 has been issued in stocks since the beginning of the year. Whereas during 1921 it was possible only in rare cases to issue bonds bearing 5 per cent interest, 43 per cent of the total amount of mortgage bonds issued in the past year bore interest at that rate.

The accompanying graph shows the fluctuations in the rate of return yielded the investor. A comparison with the figures for 1921 reveals a marked decrease in yield, which ranged from the exceedingly low figure of 5.82 to 6.90. January's issues yielded on an average 6.28 per cent, a lower figure than was reached during the entire year 1921. February's yield was the highest of the year—6.90—and from that month until August the average rate of return fluctuated, ranging from 6.22 to 6.74. After midsummer the yield continuously declined until December, when the rate jumped to 6.59.

A further evidence of the optimistic feeling prevailing in the general securities market and in the case of the electric light and power securities as a group is to be seen in the rapid and almost uninterrupted rise in the averages of stocks. It is to be noted that the trend of prices of the seven electric light and power stocks selected by the National City Company has more than kept pace with the increases shown by the industrial stocks and the railroad stocks, records of which are kept by the *Annalist*. The electric light and power stocks have over a long period of years shown fluctuations in price far less in proportion than have the other classes of stocks. The industrials must of course, in connection with deflations in prices, take considerable inventory losses. The electric utilities, however, by virtue of the fact that their only commodities on hand consist of stored fuel and electricity on the wires, are in a truly enviable position on this score.

The future of the electric light and power industry appears to be indeed bright. With more constructive rulings by many public utility commissions, with judicial recognition of the right of companies to charge such rates as will make possible a fair return on investments, and with the sympathetic attitude of a large part of the general public, the central-station companies seem to be on the verge of a period of unprecedented prosperity.

ELECTRIC LIGHT AND POWER SECURITY ISSUES IN 1922

	Amount of Issue	
MORTGAGE BONDS (average yield 6.01 per cent):		
45 issues at 5 per cent	$174,538,000	
7 issues at 5½ per cent	28,150,000	
54 issues at 6 per cent	158,902,800	
6 issues at 6½ per cent	16,045,000	
19 issues at 7 per cent	26,140,900	
1 issue at 7½ per cent	500,000	
2 issues at 8 per cent	725,000	
134 issues		$405,001,700
DEBENTURES (average yield 6.60 per cent):		
9 issues at 6 per cent	$26,800,000	
2 issues at 7 per cent	4,500,000	
11 issues		31,300,000
NOTES (average yield 6.29 per cent):		
2 issues at 5½ per cent	$16,000,000	
5 issues at 6 per cent	14,750,000	
3 issues at 7 per cent	3,800,000	
3 issues at 8 per cent	650,000	
13 issues		35,200,000
PREFERRED STOCK (average yield 6.96 per cent):		
2 issues at 6 per cent	$5,500,000	
28 issues at 7 per cent	54,346,210	
8 issues at 8 per cent	19,875,000	
38 issues		79,721,210
MISCELLANEOUS ISSUES (average yield 6.68 per cent):		
1 issue at 5 per cent	$1,000,000	
6 issues at 6 per cent	35,172,000	
2 issues at 7 per cent	1,600,000	
1 issue at 8 per cent	100,000	
2 issues	866,080	
12 issues		38,738,080
Total of all issues of year		$589,960,990

Big Strides Made in Industrial Electric Heating

By J. L. McK. Yardley
General Engineer
Westinghouse Electric & Manufacturing Company

Applications of Industrial Electric Ovens and Heat-Treating Equipment Extending — Electric Steam Boilers for Special Service Have Aroused Interest

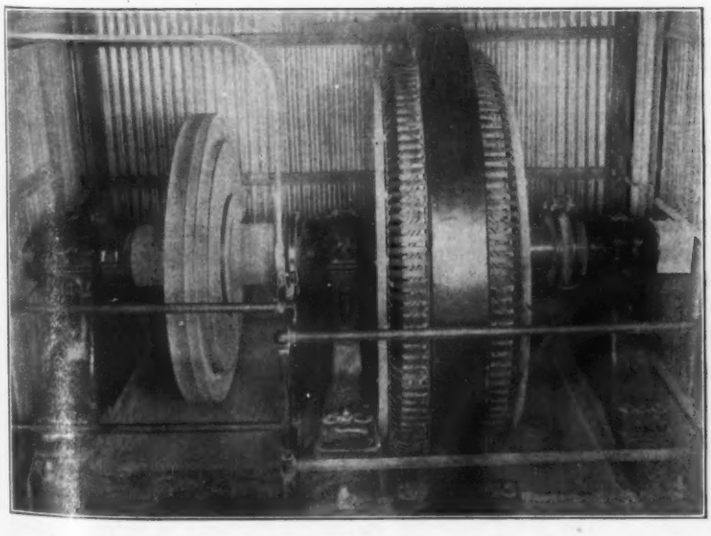
CONTINUED progress is being made in the development and application of apparatus for utilizing electric heat in industrial processes. Most striking, perhaps, are the strides which have been made in electric ovens, heat-treating furnaces and electric steam boilers. Arc-type melting and refining furnaces have become well established, and inductive heating has the inherent advantage of generating heat where it is desired, which makes its potentialities considerable. Rivet-heating apparatus has been developed to the point where it can meet moderate demands at low operating expense. Control apparatus for all of the foregoing apparatus has kept pace with these developments so that accurate and reliable operation is practically assured.

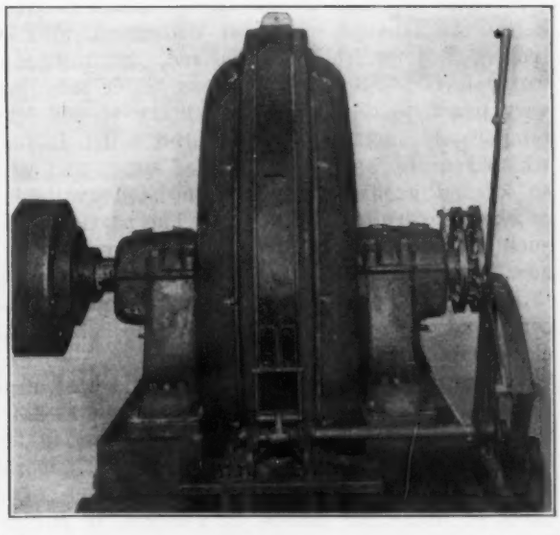
The development of the industrial electric oven rests upon a firm engineering and commercial foundation. Applications in the baking of electrical apparatus, foundry cores, japan, enamel and other processes requiring temperatures between 200 deg. and 700 deg. F. are continually extending. In the smaller sizes there is a tendency toward shelf-type ovens and toward vertical or tower construction for the particular purpose of saving floor space and employing some of the generally unutilized overhead spaces. Fortunately this sort of thing may be done in some low-temperature ovens if a relatively light conveying mechanism may be used, as the total weight is not so great but that the whole installation may be carried upon a comparatively light steel framework. Such possibilities are not inherent in industrial furnaces for higher temperature operations, owing especially to the much greater weight of refractories and heat insulation.

ELECTRIC FURNACE AT 2,000 DEG. F.

The industrial electric furnace for heat-treatment operations of many kinds gives increasing indication of coming into its own at no far distant date. In the past there has been considerable disappointment through mistakes and inadequacies in initial constructions and through misapplications, due in all cases observed to insufficient analysis and preliminary consideration of the underlying situation, the exact condition the furnace must meet and the changes in conditions which it would introduce. However, experience and knowledge have multiplied. In the approximately 20 per cent chromium and 80 per cent nickel alloy we have a heating element of very long life if it is not mistreated. We have furnace constructions in crucible, pit, chamber

Simplification Has Occurred in Machine Control and Protection and Improved Designs Are Available





The use of high torque, rotating stator, brake-band type of synchronous motor (shown at right) extends the field of application where space requirements may prevent the use of the clutch connection shown on the left.

and car-bottom types which approach in ruggedness the fuel-fired furnaces without unduly losing in efficiency. However, the details of many process applications must yet be solved by experts. Recent successful installations indicate that, with the help of moderate-priced power, we are honestly entering a period of extensive electrical applications for hardening, tempering, patterning, annealing, cementation or case-hardening and other processes requiring temperatures ranging from 1,800 deg. F. down to, say, 1,200 deg. F. The field for applications of electrical power in heat within this range of temperature is unquestionably one of the largest still potential. The estimate in the N.E.L.A. 1921 Power Sales Bureau report of a potential total connected load in glass annealing of 60,000 kw. covered merely one part of this field.

ELECTRIC FURNACE AT 2,500 DEG. F.

Probably second to the above is the extensive field of forging operations, supplemented by high-speed steel heat-treatment processes, demanding temperatures within the range of 2,000 deg. to 2,400 deg. F. If the possibility of brass melting in the more than 3,600 brass foundries of the country be included, the potential field for electric power in heat at such temperatures is indeed great. Much commendable work, both in design and in application, has been done. More remains to be done in developing furnaces which will be readily and economically applicable to such processes. The engineering difficulties are great, owing particularly to the fact that the only practical resistor elements available, carbon and graphite, are rapidly oxidizable at the temperatures required. The resistors must, therefore, be absolutely secluded from oxidizing atmospheres in order to have long life and low maintenance. Hence in these applications the competition of fuel-fired furnaces, and in the case of brass of the arc and induction types of electric furnace, has been more difficult to meet.

The electric steam boiler, which is a special form of electrode-type furnace, has aroused considerable interest during the past year or two. The principle was employed on a big scale over fifteen years ago at Niagara Falls in the three-phase water rheostats which were used for loading the then largest 12,000-volt alternators while making acceptance tests. It has been incorporated in a number of very simple boiler constructions in which the amount of steam produced, and hence the amount of power consumed, may be controlled, automatically if desired, by regulating the water level. The electric steam boiler may become a very practical and helpful auxiliary to supplement or temporarily supplant the fuel-fired boiler in industries which require large quantities of steam and which are so located geographically as to have available waste or cheap hydro-electric power. The particular field for such boilers in large sizes would appear to be as an auxiliary to hydro-electric systems in territories where it has been found impracticable to approach 100 per cent load factor with pulp grinding, electrochemical, electrometallurgical or other loads.

It appears more than probable that a host of successful applications will be found for electric steam boilers in small sizes; say 5 boiler-hp. or less, in locations having moderately priced electric power, generated by steam or water power, in special processes, in isolated parts of industrial plants, in garages, in public buildings, in laundries and domestic use, in climates having only brief and irregular periods of low temperature. Such applications probably must usually be new or isolated or beyond the capacity of existing fuel-fired boiler plants. It is obvious, for instance, that when public service companies such as the Boston Edison Electric Illuminating Company will sell steam in quantities less than the output of a 5-hp. boiler at $1.30 per 1,000 lb., and at a smaller price for larger quantities, only very special and exceptional circumstances would permit the existence of an electric steam boiler within reach of its steam lines.

Today there are probably more than a thousand arc-type melting and refining furnaces in the world, of which more than four hundred are in the United States and employed in the iron and steel industry. The special reasons for the expansion of electric steel making are the reduction of wholesale power rates, the extreme flexibility and adaptability of electric furnaces to a wide range of uses, and the quality of the products. With the electric arc furnace a reducing atmosphere can be maintained which enables the removal of sulphur and manganese sulphide, thus making it possible to readily eliminate oxides. The furnace may be used alone or in conjunction with the Bessemer or open-hearth type, or both. It may also be used in connection with the blast furnace or cupola for making semi-steel, gray-iron and malleable-iron castings. Furthermore, it may be operated either acid or basic. The popularity of the arc furnace is increasing most rapidly in the small high-grade steel or iron foundry, owing to its advantages in small units for making frequent small heats. The desirability of relatively high voltage for melting and low voltage for refining is now generally recognized.

ARC FURNACE COMING BACK

As a means of melting brass the arc-type furnace is attracting increased recognition, the advantage of rapid operation outbalancing the early criticism that the arc would unduly volatilize the non-ferrous materials. Possibly the best indication of the sound basis on which this application stands may be read in the recent announcement by one of the oldest and best known builders of fuel-fired melting furnaces for brass of a line of electric furnaces for brass melting employing the arc principles. The construction embodies the familiar pair of horizontal electrodes operated from a single-phase transformer; otherwise it retains the seasoned features of the oil-burning furnace, with some modification perhaps.

The possibilities of inductive heating should be kept in mind since it generates heat directly in the material to be heated. When suitable heat insulation is provided, the temperatures obtainable are limited only by the fusion temperatures of the best refractories.

The high-frequency induction furnace has come as a boon to the scientist engaged in the study of properties of matter at high temperature and under controllable chemical conditions. It is commercially promising for heating in vacuum, for melting silver, gold, platinum and precious alloys, and for melting of very high-grade alloys of steel and non-ferrous metals. The units are small, so that a total of over 1,000 kw. installed, or double the amount two years ago, represents a widely diversified field and indicates a growth that appears healthy.

The low-frequency induction furnace is being applied —particularly for commercial uses—in the melting of

non-ferrous metals and the production of brass. In fact, some foundries where continuous operation is the rule use this type of furnace only. New modifications of the low-frequency induction type are being brought out from time to time, indicating the interest that is taken in improving this application, although it seems to be on a successful basis already where established.

An example of the employment of commercial frequencies in a somewhat similar manner is found in the type of rivet heater in which the rivet forms a part of the transformer secondary circuit and is heated by the I^2R losses. The outstanding characteristic of this type is that the individual rivet may be heated exactly when wanted. However, constant attendance or close-control mechanism are necessary to prevent burning; otherwise, if the rivet is not required just when expected, then the energy of heating is wasted.

New Type of Rivet Heater

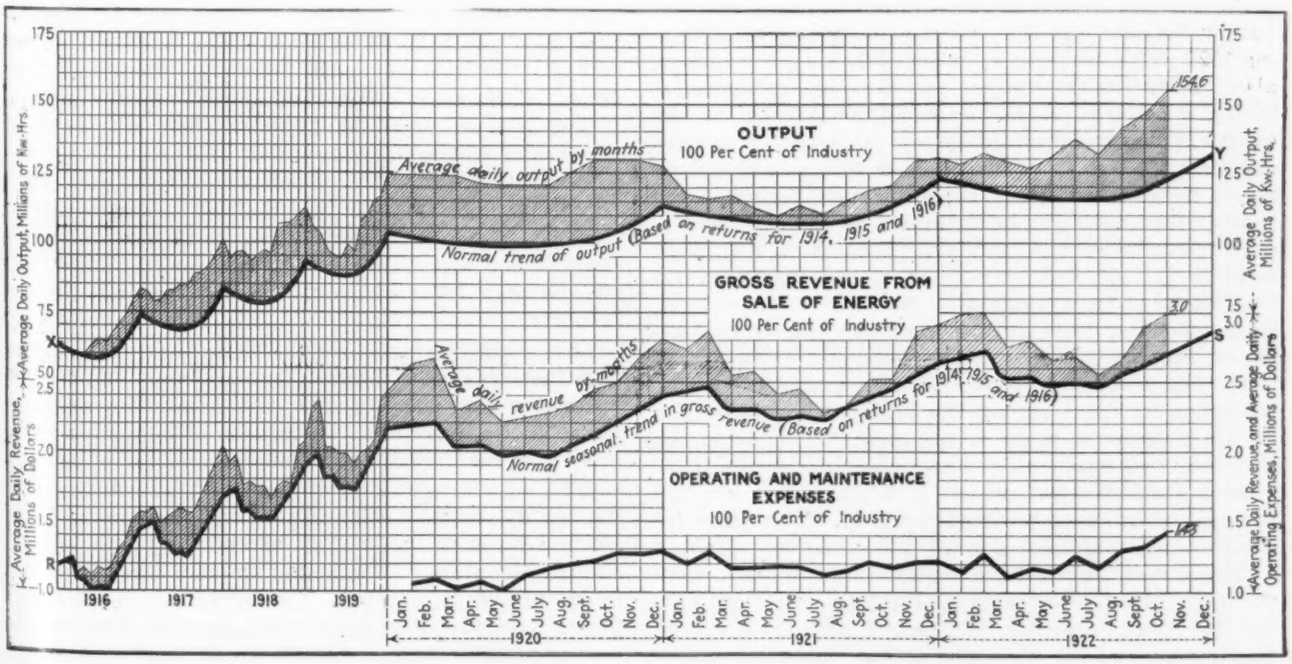
A type of rivet heater which gives promise of becoming popular consists of a chamber capable of holding fifty rivets or so, air-tight, except at the door, perhaps lined with non-oxidizing metal, and surrounded by heating elements and generous heat insulation. Such a heater kept filled with rivets and under pyrometric control is capable of meeting sudden demands for rivets in small quantities at any moment; still, it operates at a very low expense between demands owing to low radiation losses and the absence of attendance.

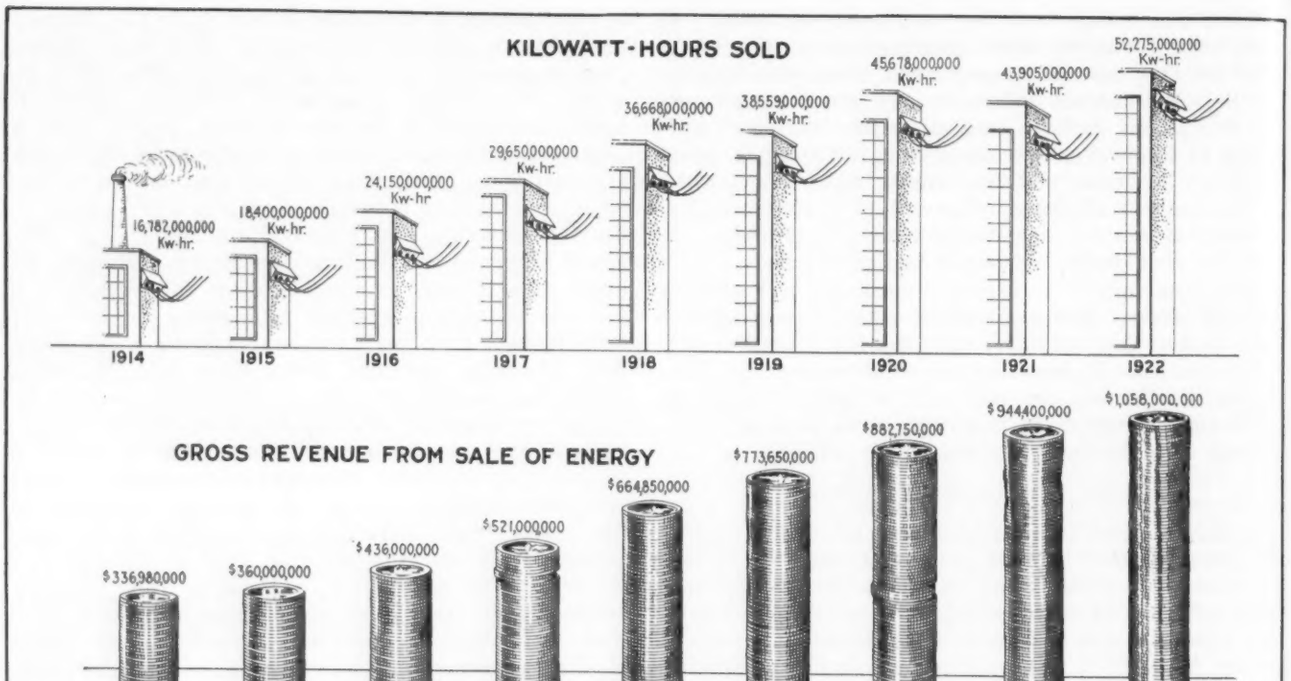
The regulation of the arc-type furnace, owing to the highly concentrated heat and intense temperature of the arc, must necessarily be controlled by current or kilowatt input. Several effective regulators have become fully developed which will hold the input with sufficient accuracy to a constant value according to the setting. The setting is changed during the cycle by the operator, as determined by the maximum permissible power demand and by the particular melting and refining periods desired for the kind and amount of charge. Induction furnaces require special controlling apparatus. For the resistor type of furnaces, at least below 2,500 deg. F., methods of pyrometric control have been fully worked out by which the electrical input in the furnace is controlled according to the temperature of the work itself by means of one or more thermocouples placed in the furnace chamber adjacent to the work. The actual temperature variation below the maximum, within a furnace chamber, over a cycle, of course, depends upon the initial temperature and weight of charge, the amount of stored heat in the furnace walls and the rate at which energy is given up by the heating elements and absorbed by the charge after power is turned on. Radiant-type heating elements disposed as uniformly as possible about the work tend to give up heat at the greatest rate, owing to the resistance to heat flow from the source being a minimum. The maximum chamber temperature and the actual operating temperature after the work has reached the desired temperature are susceptible of the closest possible control by the pyrometric method, inasmuch as commercially available indicating and recording pyrometers are highly sensitive and, through secondary relays, will actuate contactors in the supply circuit upon changes in temperature even so little as one-half of 1 per cent above and below the setting. The accuracy, flexibility and reliability of pyrometric control, more than anything else probably, constitute the appeal of the industrial electric furnace in heat-treatment processes.

Energy Output More than 52,000,000,000 Kw.-Hr.

THE year which has just closed was one of record accomplishments by the electric light and power industry. For the first time the industry really takes its place among the giants of the business world of America. The upward swing has never been so pronounced as it was during 1922, and it points unmistakably to still greater accomplishments during the coming year.

Statistically, at least, the greatest advance made during the year was in the amount of energy sold, gross income from sale of energy, increase in invested capital,


OUTPUT
100 Per Cent of Industry
Average daily output by months
Normal trend of output (Based on returns for 1914, 1915 and 1916)
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
Average daily revenue by months
Normal seasonal trend in gross revenue (Based on returns for 1914, 1915 and 1916)
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
Average Daily Revenue, Millions of Dollars
Average Daily Output, Millions of Kw.-Hrs.
Average Daily Revenue and Average Daily Operating Expenses, Millions of Dollars
Average Daily Output, Millions of Kw.-Hrs.
1546
X
Y
R
S
1916
1917
1918
1919
1920
1921
1922
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.



THE INDUSTRIAL DEPRESSION OF 1921 WAS REFLECTED IN THE SALE OF ELECTRICAL ENERGY, BUT THE YEARLY GROSS REVENUE HAS NEVER SUFFERED A DECREASE

increased installed generator rating, and the large number of new customers added to the lines. It is estimated that 52,275,000,000 kw.-hr. of electrical energy was sold by the industry during 1922, which is an increase of 18.8 per cent over 1921 and 14.4 per cent over 1920, the peak year of post-war industrial activity. It must be remembered that this huge figure does not represent the actual amount of energy consumed during 1922, but is the amount of energy actually sold by the various distributing companies, some of which was sold to other public utilities for resale and so is counted twice in the resulting tabulation.

Data so far issued by the United States Geological Survey indicate that the energy actually generated during 1922 will total about 48,100,000,000 kw.-hr., of which about 8,700,000,000 kw.-hr. was lost in transmission, giving a total of about 39,400,000,000 kw.-hr. as the electrical energy consumed by central-station customers during 1922. It is estimated that this record output figure required an added generator installation in the year of approximately 1,650,000 kw. in the central generating plants of the country. Even with this large addition to the total generator rating many central stations in intensely industrial sections of the country were reporting inability to supply the energy requirements, especially during November and December.

For the first time the electric light and power industry takes its place among the billion-dollar industries of the country in value of products. It is estimated that the gross revenue from sale of energy during 1922 totaled $1,058,000,000, which is $113,600,000, or 12.0 per cent, above that reported for 1921. This large increase is undoubtedly due to the addition of about 1,200,000 new high-revenue domestic lighting customers and about 150,000 commercial lighting customers during the year, although the record industrial energy requirements of the last third of the year must not be overlooked in this connection. It is estimated that the operating and maintenance expenses of the industry totaled $484,000,000 during 1922, which is approximately $52,000,000 over that reported during 1921. The expenses for the year would undoubtedly have been materially less had it not been for the coal shortage and consequent high price of fuel in the last half of the year.

In amount of invested capital, the electric light and power industry assumes a place of added importance as a member of that select group of six industries with a capitalization of more than five billion dollars, the other members of which are chemicals and allied products, food and kindred products, iron and steel, mines and quarries and the textile industry. The capital invested in the electric light and power industry on Jan. 1, 1923, is estimated at $5,100,000,000, which is an increase of $500,000,000 over that of Jan. 1, 1922. The National City Company, which keeps very close new-capital tabulations, estimates that of this new capital invested in the industry during 1922 approximately $250,000,000 was from the sale of securities and $250,000,000 was from reinvestments of earnings in the property.

The accompanying curves indicate that the average daily energy sold during October was 154,580,000 kw.-hr., which was 5.4 per cent above the previous record figure, reached in September. The average daily gross revenue from the sale of energy during October was $3,006,000, which was a few thousand dollars below the record revenue reported during February, 1922. Every section of the country except the South Central and the Mountain Pacific States reported large increases in output over September. The decrease in the Western States was probably due to the seasonal decrease in energy requirements by irrigation customers.

Hydro Projects Will Total $778,300,000

Active Applications Filed with the Federal Power Commission Total 334, Involving 17,692,109 Primary Horsepower — Projects Involving 2,531,489 Primary Horsepower Now Under Construction

THE activities of the Federal Power Commission form an excellent barometer of present and future hydro-electric developments in this country. There are very few water powers of any magnitude the development of which does not to some degree affect public lands or navigable streams, thereby falling under the jurisdiction of the Federal Power Commission.

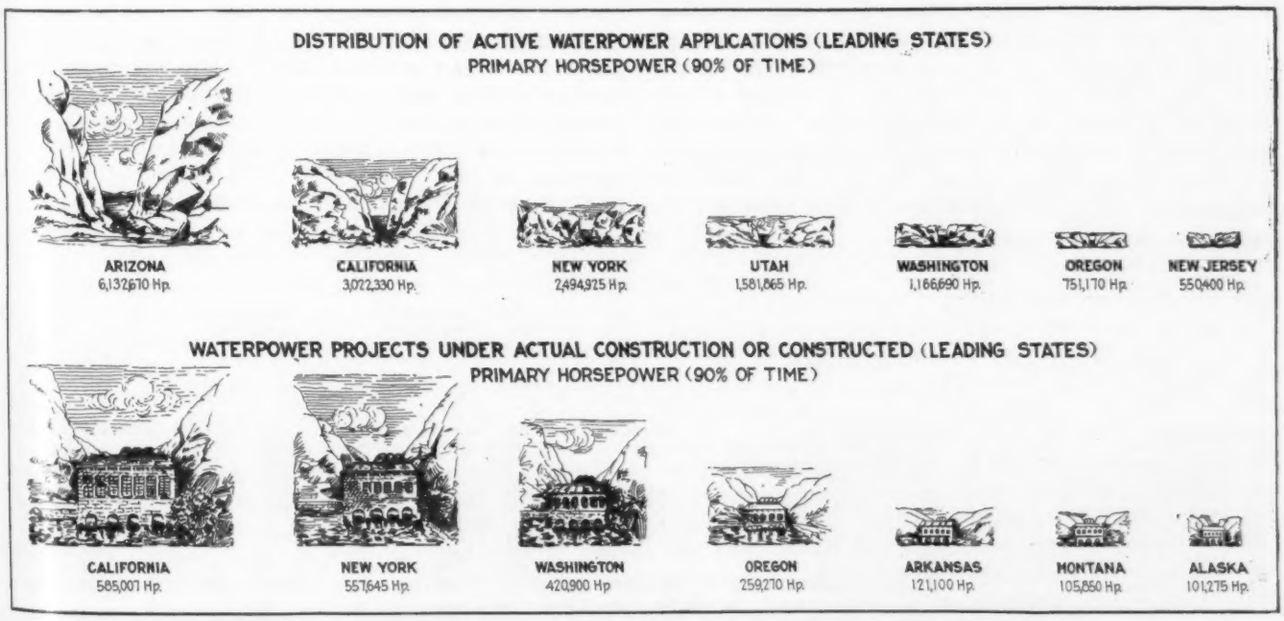
On Dec. 1 334 active applications were on file with the commission, of which thirty-four were for transmission lines. The projects involved in these applications total 17,692,109 primary horsepower available 90 per cent of the time and an estimated installed capacity of 27,804,394 hp. During the fiscal year 1921 a number of deductions were made on account of withdrawals and rejections. These, if included, would involve a total of 21,004,759 primary horsepower and an installed capacity of 31,938,694 hp. The Federal Power Commission has issued sixty-nine final permits and sixty-five licenses, involving a total of 2,531,489 primary horsepower and an estimated installed capacity of 4,898,509 hp. The distribution of these hydro-electric projects by states will be found in Table I.

The estimated capital involved in the water-power projects now under preliminary or final permits and licenses totals $778,300,000, distributed as follows:

Investment involved in projects now under preliminary permits, if finally constructed under licenses	$576,000,000
Investment involved in projects under license constructed and under construction	283,200,000
Investment involved in projects already constructed at time of obtaining license	80,900,000
Net investment involved in projects now being constructed	202,300,000
Total investment involved in projects now under construction or to be constructed under license, plus investment involved in projects now under preliminary permits	778,300,000

Assuming that for each kilowatt developed $110 will be spent for transmission equipment, $100 for distribution installation and $750 for customers' lamps, motors and appliances and wiring of houses and factories, a total of about $4,993,000,000 will be spent as a direct result of these developments. Adding these two totals together gives a total probable capital investment of about $5,771,300,000. This figure does not take into consideration the further investment for reserve steam-plant equipment, which would undoubtedly bring the total amount thus invested to well over the six-billion-dollar mark.

Probably the most significant fact to be derived from these figures is the insistent demand all over the country to have water power developed. This is doubtless primarily the result of the post-war coal situation, but the movement has been materially aided by the passage of the federal water-power act. Coupled with this is the thought that east of the Rocky Mountains practically all feasible water power is likely to be developed within a comparatively short time, although in this area coal will probably always be the mainstay for power production. In the West there is ample water power to supply all needs for at least a century, and probably much longer, and as time goes on the relatively cheap power of this region would seem almost inevitably to lead to the building up of industrial centers of considerable magnitude. A start in this direction has already been made. In a few regions such as central California and the Salt Lake basin complete development of the important water powers is already in sight, but in these localities there still remains a possibility—



CALIFORNIA AND NEW YORK EASILY LEAD IN WATER POWERS ACTUALLY UNDER CONSTRUCTION OR CONSTRUCTED UNDER THE FEDERAL POWER ACT

TABLE I—ACTIVITIES OF THE FEDERAL POWER COMMISSION COVER EVERY SECTION OF THE COUNTRY

State and Section	Distribution of Active Applications: Number of Water-Power Applications	Number of Transmission Lines	Primary Horsepower (90% of Time)*	Est. Installed Capacity**	Distribution of Licenses Authorized: Number of Water-Power Licenses	Number of Trans.-Line Licenses	Primary Horsepower (90% of Time)	Est. Installed Capacity	Distribution of Permits Authorized: Number of Water-Power Permits	Primary Horsepower (90% of Time)	Est. Installed Capacity
United States	300	34	17,692,109	27,804,394	40	25	883,969	2,079,524	69	1,647,520	2,818,985
SECTIONS											
New England	2	0	50,000	50,000	0	0	0	0	1	20,000	20,000
Middle Atlantic	19	0	3,312,325	4,554,130	3	0	346,495	624,330	2	212,500	262,500
South Atlantic	17	2	129,550	259,130	0	1	0	0	9	34,430	101,530
East North Central	6	0	55,353	82,650	2	0	10,210	20,250	2	42,850	54,250
West North Central	17	1	144,130	296,800	0	1	0	0	5	22,700	47,700
East South Central	14	0	198,280	556,250	2	0	25,330	106,000	3	3,015	15,000
West South Central	8	0	156,000	289,200	1	0	17,400	60,000	4	143,700	241,000
Mountain	67	11	8,397,351	11,677,309	10	10	8,719	25,869	12	277,645	579,625
Pacific	115	20	4,940,190	9,622,160	17	13	470,567	1,236,010	18	794,610	1,356,830
Alaska	35	0	308,930	416,765	5	0	5,205	7,065	13	96,070	140,550
RANKING STATES											
Arizona	13	1	6,132,670	8,231,000	0	1	0	0	2	73,400	150,000
California	83	18	3,022,330	6,072,310	14	12	445,107	1,205,850	8	139,900	253,150
New York	9	0	2,494,925	3,072,830	2	0	345,145	580,330	2	212,500	262,500
Utah	8	0	1,581,865	2,238,665	1	0	40	40	3	7,225	13,625
Washington	18	1	1,166,690	2,040,410	1	0	100	100	4	420,800	623,800
Oregon	14	1	751,170	1,509,440	2	1	25,360	30,060	6	233,910	479,880
New Jersey	3	0	550,400	662,300	0	0	0	0	0	0	0
Alabama	9	0	102,130	364,000	2	0	25,330	106,000	3	3,015	15,000
Arkansas	6	0	112,000	230,200	1	0	17,400	60,000	3	103,700	186,000
Wisconsin	1	0	10,043	20,000	1	0	10,043	20,000	0	0	0
Alaska	35	0	308,930	416,765	5	0	5,205	7,065	13	96,070	140,550
Other states	101	13	1,458,956	2,946,474	11	11	10,239	70,079	25	357,000	697,480

* Add 3,312,650 hp. for deductions made during fiscal year 1921 on account of withdrawals and rejections for total applications.
** Add 4,134,300 hp. for deductions made during fiscal year 1921 on account of withdrawals and rejections.

one might almost say a certainty—of obtaining large blocks of energy by long-distance transmission lines from regions in which a great surplus of water power is available.

The administration of the water-power act by the Federal Power Commission has been hindered by an insufficient engineering staff, the direct result of small Congressional appropriations. The cost of administering the act has been low, especially when the flood of applications involved is taken into consideration. The commission's expenses for the fiscal year ended June 30, 1921, its first year of operation, were $29,371.74, of which about one-third was the cost of the initial equipment for its offices. The commission deposited in the Treasury $8,963.57 from fees prescribed in licenses issued during that year. The operating expenses for the fiscal year 1922 in round numbers will be $37,000, and receipts, including land rentals, will total $29,000. Therefore, the net cost of operations during the second year will be $19,500, as compared with $20,630.09 for the first year. With the exception of the salary of the executive secretary of the commission, the salaries have been borne by the three government departments, according to the water-power act, and the field work has been largely delegated to the field forces of these departments.

Following is a summary of the cost of administering the federal water-power act during 1921 and 1922:

	1921	1922
Operating expense	$29,371.74	$37,000.00
Salary expense	59,878.63	81,049.78
Field expense	20,710.00	30,000.00
Gross expense	$109,960.37	$149,971.78
Deducting administrative fees received from licenses for water-power development	8,741.65	24,500.00
Net cost of administering the act	$101,218.72	$125,471.78

Table II gives detailed cost data on some of the more important projects now under construction. Cost data on other projects under construction appeared in the May 13, 1922, issue of the ELECTRICAL WORLD.

Some valuable cost data are also contained in the applications for transmission lines. The 220,000-volt, single-circuit, three-phase steel-tower line leading from the Pit River development in California is especially interesting. One section of this line consists of 27.8 miles of steel-reinforced 518,000-circ.mil aluminum-steel reinforced cable and 32.2 miles of 500,000-circ.mil stranded copper; the total section is estimated to cost $1,060,000, exclusive of right-of-way or overhead charges. Another section consists of 32.2 miles of 500,000-circ.mil stranded copper and cost $470,000.

TABLE II—COST ESTIMATES ON IMPORTANT PROJECTS BEING CONSTRUCTED UNDER LICENSES ISSUED BY THE FEDERAL POWER COMMISSION

No. of License	Name of Company	Name of Stream	Total Cost of Dam	Total Cost of Power House	Hydraulic Equipment: Hp.	Hydraulic Equipment: Total Cost	Electrical Equipment: Kva.	Electrical Equipment: Total Cost	Project as a Whole: Total Cost	Project as a Whole: Cost per Installed Hp.
309	Clarion River Power Co.	Clarion River, Pa.	$1,800,000	$450,000	44,000	$350,000	41,500	$875,000	(a) $6,460,000	$147
155	Southern Sierras Power Co., No. 1.	Fall and Snow Creeks, Cal.	.....	27,500	3,750	20,000	2,000	43,000	(a) 656,000	175
155	Southern Sierras Power Co., No. 2.	Fall and Snow Creeks, Cal.	.....	27,000		15,000	1,500	33,000		
135	Portland Ry. Lt. & Pwr. Co.	Oak Gun Creek, Ore.	.....	110,000	30,000	240,000	25,000	270,000	(a) 2,685,000	90
271	Caddo River Pwr. & Irr. Co., No. 1.	Ouachita River, Ark.	1,680,000	224,000	40,000	480,000	37,500	684,000	(a) 3,900,000	98
271	Caddo River Pwr. & Irr. Co., No. 2.	Ouachita River, Ark.	2,000,000	222,000	40,000	390,000	37,500	644,000	(a) 4,155,000	104
120	Southern Calif. Edison Co., No. 3.	Big Creek, Cal.	1,200,000	.....	195,000	.....	.....	.....	13,089,000	67
20	Utah Power and Light Co.	Bear River, Ida.	470,000	430,000	21,000	170,000	20,000	350,000	(a) 2,500,000	119
187	Yuba Development Company	Yuba River, Cal.	600,000	25,000	1,000	.....	.....	.....	894,200	128
185	Southern Sierras Power Co.	Mill Creek, Cal.	.....	27,000	3,300	25,000	3,000	87,000	(a) 630,000	190
52	City of Dothan	Choctawhatchee River, Ala.	(b) 503,500	.....	3,000	31,000	2,800	73,000	(d) 658,000	220

(a) Overhead included in total cost but not in detail items. (b) Includes Power house
(c) Dam already built, cost of power-house and equipment included under electrical equipment. (d) Exclusive of land damages and engineering.

Practical Economies the Keynote

By Earl E. Whitehorne
Commercial Editor ELECTRICAL WORLD

Manufacturer and Distributor Have Determined to Eliminate Waste Through Standardization, Simplification and Curbing Useless Competition

FROM the viewpoint of the manufacturer and the jobber the past twelve months in the electrical industry have been extremely interesting and significant, and the next year promises even more important developments. As in nearly all other industries, the overshadowing problem of the moment is one of practical economies. A great desire is expressing itself through every branch of industry that ways may be found to reduce the cost of the nation's goods through the elimination of waste both in distribution and in production. This has an academic sound, but it remains the fact and it affects all men; and the year has seen a very practical evidence of the determination of both organizations and individuals at least to start some effort that will help toward the realization of such a benefit.

Courage has come back into the business of the country, and there has been much intensive selling both by the manufacturer and the distributor, but it has not been the type of free and open market building with intense absorption in the pursuit of orders that we knew for so long before the war and through the days of boom that followed. There has been an unhappy strain running clear across it. For while men have been busy, they have not been enjoying the measure of prosperity that the volume of business would seem to indicate. Good times were seen to be returning, and yet it was patent to all that these "good times" were unhealthy at the core and it was known that "something" had to be done to cut down costs, relieve excessive prices and produce profits that would compensate for the work and risks entailed. And so a spirit of unrest has existed and there has been a struggle for relief manifested in several directions.

THE NEED FOR SIMPLICITY

Manufacturers have more generally begun to recognize the need for simplification of their lines through reduction in the great number of excess varieties. They have been scrutinizing their catalogs and devising ways to retire numbers that differ only superficially and duplicate one another in the essentials and by this duplication increase inventories for both the jobber and dealer as well as for the manufacturer, eventually causing increased cost to the ultimate purchaser.

At the present time, to take a common illustration, there are on the market an unconscionable number of sockets. Again, one manufacturer has actually on schedule 3,200 standard motors, most of them differing from one or many others only in some trifling detail that might well be brought to a common standard but for the profligate habit of giving unnecessarily costly service and paying extravagant deference to the whims of the buyer or the endeavor to develop something just a little "different" for a "selling argument." There is no lack of other striking examples within the observation and knowledge of every one.

How to deal with the actual act of simplification—how to proceed—is the unanswered question. That such excesses exist in many lines is recognized freely, but fear of competition interposes many obstacles to action. Many believe that if they "cut out" this type or that, some other firm will specialize upon it and profit at their expense. Moreover, the process of simplification must be so under control that it will not exert an influence against the development and perfection of new inventions and stifle the progress of the art and the industry.

THE NEED FOR STATISTICS

It is also the common concern of both the manufacturer and distributor that their part of the electrical industry is today operating almost without statistical knowledge. As a result there has been a tremendous amount of varied and hit-or-miss production and numerous cases of over-stock or under-stock due to ignorance of the market. The industry, for example, does not know how many small motors are made in any period, nor what at any time has been the production or the sales, nor what is the condition of the stocks over the country. It is the same with other commodities.

The practical usefulness of such statistics in these times is clear. For such knowledge would in itself tend to reduce stocks of both raw materials and manufactured products and to decrease the number of styles, types and varieties. It would also produce a greater flexibility in the adjustment of price changes and the maintenance of adequate reserves. Today, when a slump in business comes unexpectedly, no one is cognizant, except in the most general way, either of its cause or its probable duration or effect, and factories proceed as long as possible running at full time and building up stock, buoyed up by the hope that an early reaction will find them in readiness for profitable sales. And this old stock but adds to the confusion and the burden of the situation.

These are all influences in production and in distribution, elements in the present excessive cost of goods, part of the problem which all men of the industry are pondering today. Electrical men are trying to see their way through and out of it and realizing more and more how all are involved in it, the burden that it lays upon the business of the light and power company and the contractor, as well as the manufacturer and jobber. For it is in these fundamentals, these background elements, that the trouble apparently lies.

Through a period of thirty years of rising prices,

increasing prosperity and advancing standards executives of the industry have kept too close a focus upon themselves and their own organization problems of activity and growth and have given little concern to the economics of the industry itself. It has been no part of the bustle of the business day to see that the electrical industry was fabricating all its parts into an efficient and enduring system.

THE NEED FOR INSPECTION UNIFORMITY

And so, to glimpse another side of it, there has evolved through all the influences of chance a great diversity of state and governmental requirements resulting in a baffling absence of uniformity in inspection standards in different sections of the country. A safety switch, for instance, might be required in Oregon to have its cover hinged on the side, in Colorado at the top, in Ohio at the bottom, and in Connecticut all hinges might be banned and screws required. Wide difference is found in the requirements for fusing and connecting motors and in other details of electrical installation where either fire or safety hazard is involved, varying not only with the state and city but often with the interpretation given to these rules by local inspectors.

Such a condition, developing gradually through lack of guidance and control, has naturally administered a further impulse to the increase of varieties and stocks and added just so much more to the burden. It will inevitably demand some sort of a constructive, remedial treatment that will establish uniformity and eliminate the waste now so conspicuous by setting up common standards that can be applied throughout the land and that will afford a greater measure of stability because they will not change too rapidly or without ample warning so that stocks and production may be adjusted.

These are all parts of the picture, elements in the all-embracing economic problem that is engaging the best minds of industry today. It is a time of close analysis. Men are searching for facts and the process has not yet reached a stage where these facts have been made articulate to any satisfactory extent. But there are plenty of definite evidences of the inclination in the electrical industry through the closer organization of the groups and the greater activity they are exhibiting. The union of the Associated Manufacturers of Electrical Supplies, the Power Club and the Electrical Manufacturers' Club is an expression of it. The twelve months' analysis of the jobbers' cost of doing business which became available this year is an expression of it. The investigation into the cost of merchandising by large central-station companies reported this fall is an expression of it. The organization of separate merchandise departments by the industry's two largest manufacturers, to focus constructive effort on the development of better retailing through the industry, is an expression of it. The closer relations which have been established between these two great manufacturing institutions and the respective groups of jobbers who form their distribution systems is another expression of it. It is a broad mass movement in the right direction, a general impulse driving men to find the truth as their only recourse if the problem that besets them is to be solved.

But there is no place where any one can put his finger on the record of last year and say: "Here is where the movement started. Here is what has been accomplished." It is all in the formative stage in which men have been spending more time in looking beyond their own office walls and studying their industry. And they have done more than this. They have talked and argued out some common principles and purposes and they have taken practical, progressive steps to organize these purposes into co-operative action.

Simplification is a problem of production. First, it is a problem of the individual because each manufacturer first must scrutinize his own line and see where he can save. Then it becomes an industry problem if uniformity and standardization are to be achieved. And already many companies are taking the first steps in this elimination process.

PROBLEMS FIRST OF THE INDIVIDUAL

The production of statistics is also first a problem of the individual, for each man must make up his own mind that he will develop the statistics that are needed on his own production and contribute them to the knowledge of his industry. Then it becomes a matter of compiling and combining these statistics into mass figures. A considerable degree of progress has been made toward the establishment of such a statistical service from the electrical industry, to report on production, stocks and sales, the figures to be cleared through the United States Department of Commerce in accordance with the plan of Mr. Hoover.

And to a certain degree in the same way the more immediate and pressing problem of waste in distribution is first of all an obligation on the individual. For, although one is apt to think of it as essentially a trouble with and of the jobber, the fact remains that all have a part in it. The line that the manufacturer sells the jobber and the way he sells it is a part of it. The material that the central-station company, contractor or dealer buys from the jobber and the way he buys it is a part of it. For excess varieties, shipping units that require avoidable repacking, overstocking through ignorance of market trends, small-order purchasing and extravagant demands for service all contribute to the price that must be charged when goods are sold. And all this is now being recognized more and more, for the public is insistently demanding a less expensive system of distribution of the goods it buys, and there is a power behind such a demand that cannot be denied.

TOO MUCH COMPETITION

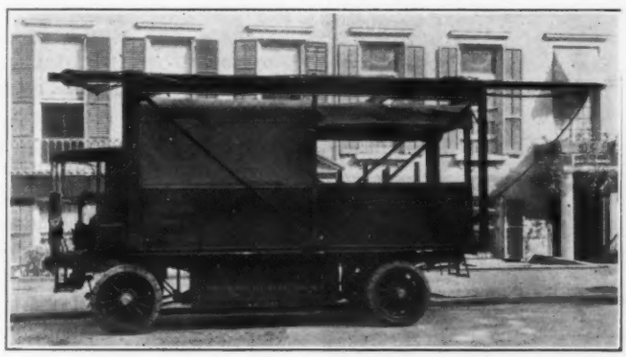
Steadily comes the growing conviction that at the bottom of it all is an uneconomic excess of competition—too many manufacturers producing duplicating lines in too great variety and too small volume, too many jobbers stocking and selling too many lines of too many articles and both buying and selling them in too many small shipments, too many contractors and retailers doing each so small a part of the available business that too few can prosper. It is the outgrowth of the rapid rise of this electrical industry, which has made it a loadstone to ambitious men. It is the product of boom times and quick expansion. And the inflexible laws of economics will operate and through consolidations and bankruptcy reduce this waste, also a painful but a curative process as it affects the industry in its entirety.

These have been the movements of the past year. These are the trends that will be seen in active progress through the years immediately ahead. And wise is the man who will take heed and look ahead into this evolution, that he may find and take his place in it.

Commercial Trends of the Year

An Analysis of Central-Station Commercial Practice Shows a Spectacular Awakening to New Thoughts, Activities and Policies

OUT OF the background of the year that has just passed stand some very definite and important trends in central-station commercial practice. There have been no revolutionary changes, no violent contradictions of former theory. Rather there has been a reawakening, part of the general recovery from the commercial doldrums in which the business of the country was so long becalmed. But is has been a spectacular awakening, and out of it have come abrupt transitions of thought and policy that are notable in the commercial history of light and power companies. And some of the incidents of this awakening offer valuable material for guiding thought on the part of executive and department managers who have in their keeping the framing of the programs for commercial development that will function through the next few years. During 1922 the central-station industry apparently succeeded in shaking off the apathy that followed the benumbing influences of the war, when, from the standpoint of commercial organization, the companies found themselves, in a bad way. Salesmen had been transferred to other departments or been discharged or had found for themselves other jobs when the selling activities were curtailed or abandoned. Department managers had gone elsewhere to find a living opportunity or had become so demoralized and discouraged by the restrictions put upon them that for the most part they were either treading water or drifting with what little progressive current they could discover. Executives had turned their minds from the subject and occupied themselves with other things. Then suddenly it came over them all at once that times at last were changing—had changed.



THE ELECTRIC VEHICLE HAS PROVED ITS ECONOMY IN CITY DELIVERY SERVICE

For money had at last become plentiful and cheap enough to borrow and to spend. People had begun to buy things once again with something like the pre-war appetite. It had therefore again become possible to take up the work of creative market development and sell light, heat, power and appliances in the old way or a better way, and to provide capacity where expansion could not be undertaken without it.

This change of heart came in a great, slowly gathering ground swell of sentiment that swept the industry from stem to stern. Department managers felt the unfolding of opportunity for renewed selling and appealed to their chief. The executives thought more and more about it, talked together when they met and gradually gained conviction. Finally the hobbles began to be loosened and commercial staffs were told to go ahead. And it was only a step from there to the point where the executives were beginning to exert pressure upon their selling people to speed up the program for new business, and that is substantially the state of things today. But it is not so simple as it looks, because comparatively few central stations have carried through an organization adequate for the proper handling of the situation now that the time is right and the word has come to go ahead. This commercial reawakening in the central-station world, this new, eager effort to get back to work and sell electric service to the community for all that it may do, has manifested itself in very clear-cut reactions. There is probably no executive and no department manager who would not have preferred to sit back and make a careful analysis of the market and the opportunity—as to both the qualitative and the quantitative aspects. For it is only in the well-balanced selective development of business that the highest returns of profit can be obtained and the highest value in service rendered. But the spirit of the year was all against it. The demand was for something to be done at once, and the facilities for doing the job were almost universally inadequate. Therefore the only course was to turn to the most available source of business and to attempt to specialize on selling that would bring the best results with the minimum of work and delay.

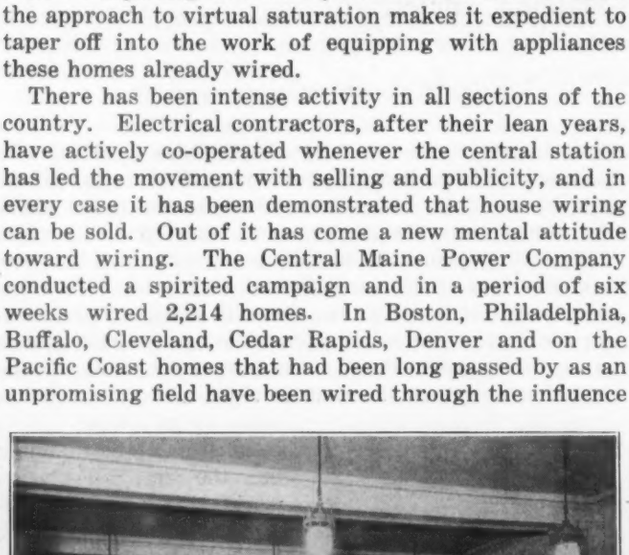
The result has been a very extensive activity in the stimulation of house wiring by central stations, a new movement to develop a better standard of store and window lighting, renewed interest in appliance retailing, followed by a searching inquiry into merchandising policies, and a very much greater attention to the possibilities of the electric vehicle. At the same time the sale of industrial power and heat has stiffened and increased, and a very general movement has been seen in the demonstration of electrical appliances to the public, as an educational influence, and in the organization of co-operative leagues representing all the electrical interests in a community to advance the common cause.

All these things, of course, are not the clear-cut products of the year 1922 alone. In several instances headway had been gathering for some time back, but it is fair to say that the trend crystallized in 1922 into definite form and progress that demands attention.

The trend in wiring has been spectacular. In Cincin-

nati twenty thousand homes were wired last year and 15,000 the year before in a great, intensive drive to put electric light into every household. The work has been done by organized high-pressure selling with a crew of salesmen working from house to house. This campaign is now completing its second year and will continue until the approach to virtual saturation makes it expedient to taper off into the work of equipping with appliances these homes already wired.

There has been intense activity in all sections of the country. Electrical contractors, after their lean years, have actively co-operated whenever the central station has led the movement with selling and publicity, and in every case it has been demonstrated that house wiring can be sold. Out of it has come a new mental attitude toward wiring. The Central Maine Power Company conducted a spirited campaign and in a period of six weeks wired 2,214 homes. In Boston, Philadelphia, Buffalo, Cleveland, Cedar Rapids, Denver and on the Pacific Coast homes that had been long passed by as an unpromising field have been wired through the influence



GOOD ILLUMINATION IS A RECOGNIZED ASSET IN SALES STOREROOMS AND APPLIANCE SHOPS

of a selling impulse that emanated from the central station. The central station, therefore, is beginning to recognize the great opportunity for load building that can be developed through the installation of electric facilities in more and more homes. In Cleveland, St. Louis and other cities this has taken the form of a service to furnish wiring plans that is having great influence in increasing the number of outlets going into homes and in bettering the market for appliances.

The trend toward store lighting appeared for two reasons: Present conditions offer tremendous opportunity for improvement; then it is a business that is easily accessible, because the stores are for the most part grouped in a shopping center, and any success in selling improved equipment to them will set up a wave of interest in improved illumination among all merchants. A recent survey in Cleveland developed the fact that 30 per cent of the store lighting and 72 per cent of the window lighting could be classed as poor, and this in itself indicates the amount of business that awaits the central station in this field.

NEW INTEREST IN STORE LIGHTING

A very definite effort is being made under the leadership of the N. E. L. A. Commercial Section Lighting Sales Bureau to prepare statistical data on store-lighting practice that will give the salesman the same sort of well-grounded facts that have been in a large measure responsible for the improvement in the standard of industrial illumination. In Chicago, in Boston, in New Orleans, in Duluth, the lighting companies have been particularly active in this work and have made remarkable progress. The attention of the industry has been aroused and store lighting is proving a most profitable source of increased business.

MERCHANDISING POLICIES AN ISSUE

The trend in appliance selling has been a matter of almost universal interest. With the general quickening of household buying, dealers and central-station companies have put more and more effort into the sale of household services and the market has responded. In Chicago a system of selling from wagons was introduced, each wagon working in a district, served by a crew of canvassers who sold from house to house, and so successful has the effort been that in spite of the fact that the central station there maintains a very large electric shop and five branch stores, about 60 per cent of all appliance sales are being made by the outside men.

There has also been an interesting movement by a number of central stations toward the establishment of branch stores. The Texas Power & Light Company, the Kansas Gas & Electric Company and the Pennsylvania Power & Light Company have all opened a chain of stores in the various communities they serve, and in these the appearance of the store and the method, stock, prices and policies have been standardized. So well has the idea of central-station merchandising taken hold that the Union Gas & Electric Company of Cincinnati, having sold out its appliance business some time ago to an independent dealer, has bought it back again and is organizing for an energetic appliance-selling campaign. In Philadelphia the company has adopted mail-order methods and a far more aggressive policy.

The whole central-station industry is gradually becoming convinced that the light and power company should sell appliances and at a profit, and this has led to a thorough investigation of the present cost of selling merchandise by a group of the larger companies. As a result it has been demonstrated, as was announced in the fall, that as a class central-station companies are ignorant of their cost and are actually losing money on appliance sales. This has focused the thought of the entire industry on the weakness of present merchandising policy. Much good is bound to result.

VEHICLES TO THE FRONT

The electric vehicle is coming surely back to life as a central-station commercial objective. The trend is unmistakable. In New York, Chicago, Boston, New Orleans, Los Angeles and Fresno vehicle departments are now in operation. Realization that one 5-ton truck will consume 10,000 kw.-hr. per year, or the equivalent of 100 flatirons, is making an impression on the minds of executives who are looking about for load. Manufacturers have responded to this encouragement and are advertising to truck owners more energetically and effectively. A parade of 125 electric trucks was staged on Fifth Avenue during the Electric Show in New York, and a fleet of electric taxicabs is now in operation in that city. The electric vehicle is gaining.

Power sales have been maintaining a steady progress, but it is no longer necessary for the power salesman to camp on the prospective power user's doorstep to

secure his motor load. Central-station power salesmen have succeeded in establishing personal confidence, and power users are now ready to accept their statements of the advantages of electric drive.

One feature which has been overlooked is the installation of adequate lighting equipment in factories at the same time that motors are put in. Some companies, notably the one in Dayton, have made headway in this direction. Power customers are depending more and more on the advice of power engineers on motor equipment, particularly in application to special machines. Frequently when new machines are bought from tool manufacturers, instead of ordering motors to come with the machines the central station is called upon to specify the motor.

Industrial Heating Increasing Rapidly Because of Its Economy

Industrial heating is rapidly coming to the front, and it is expected that it will ultimately exceed the motor load. Installations of enameling ovens with connected loads from 300 kw. to 1,500 kw. have become not uncommon. Strangely enough, the larger installations are easiest to sell, probably because of their great economy, which the larger industries are quick to recognize. The smaller devices, such as muffle furnaces, small heat-treating ovens, soldering irons and so forth, still require considerable educational work.

Industry Promotion Work

The most conspicuous expression of this awakening of commercial thinking and activity in the electrical industry has, of course, been the organization of the Joint Committee for Business Development to lead a broad industry-wide movement for more and better business. It embraces in its membership today the following associations:

Association of Electragists—International.
Canadian Electrical Association.
Electrical Manufacturers' Council, consisting of the Associated Manufacturers of Electrical Supplies, Electrical Manufacturers' Club and Electrical Power Club.
Electrical Supply Jobbers' Association.
Fixture Dealers' Society of America.
Illuminating Glassware Guild.
National Council Lighting Fixture Manufacturers.
National Electric Light Association.
Society for Electrical Development.

Representing all branches of the industry, this committee is endeavoring to knit together the combined efforts of all into a balanced, progressive campaign that will speed up the development of this waiting market.

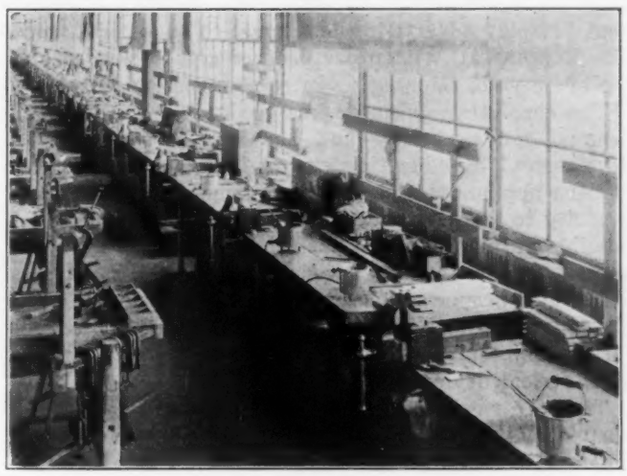
Forming a Co-operative Agency Under the Leadership of the Central Station

The very fundamental of its philosophy is that the central-station company must assume the creative leadership of electrical promotion work in every community, and the emphatic expression of the doctrine has undoubtedly done much to impress upon central-station executives not only the fact that it is time to go after business once more, but that the light and power company must initiate, inspire and guide the local co-operative work. Through the co-operation of the jobbers and contractor-dealers a census of the entire country is being made to determine who are the men in each town best fitted to serve as a committee of three to maintain contact with the Joint Committee for Business Development and become the nucleus of a local league of electrical men. About one thousand five hundred communities have already been analyzed, and the work of establishing committees is going forward.

The Society for Electrical Development is acting as the workshop of the joint committee and actively promotes the organization of electric leagues. At the call of the society a conference of local league representatives was held last fall and a number of new leagues are being established. At the present time there are about forty-five local co-operative associations of this kind in operation.

Home Electric Gains in Popularity

Meanwhile the "home electric" has gained steadily in popularity and effectiveness. More than eighty of these practical demonstrations of electricity in the home have been exhibited in nearly as many cities to an average attendance of twenty thousand, and thus more than a million and a half people have been able to hear the whole story and see what modern electric service can be made to mean in the household. One central station after another is beginning to realize that here is a great



SMALL HEATING DEVICES HAVE BECOME POPULAR IN INDUSTRIAL SERVICE

opportunity to carry its message to a great self-selected audience of interested householders. And whereas a few years ago the "home electric" was a new idea, an enterprising novelty, today it has reached the stage of common practice among companies that are commercially alert.

Such is the story of the commercial activities of 1922 among the central stations. There has been a conspicuous increase in general activity along the line of business promotion in practically all sections of the country, but it has not been of uniform intensity as applied to all classes of business. It has not been a general advance on the market in which the selling has been directed to all possible sources of opportunity, although that has been the desire. Rather it has been an effort to turn "prospects" into new load and income wherever the short-handed and disorganized commercial personnel could make the quickest contact and produce the most effective results. Undoubtedly it indicates the course which will be followed in the coming months. It promises progress, particularly in wiring, in store lighting and in merchandising. At the same time through invention of new devices and a greater realization of uses for electricity opportunity is afforded to secure a great volume and diversity in load and to more readily secure a variety of business.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Co-operation the Keynote of Expansion

To the Editors of the ELECTRICAL WORLD:

I would like to suggest to you a matter that has been in my mind for many years with reference to the necessity for co-operation between the various branches of the industry. I have the viewpoint of a consulting mechanical and electrical engineer and also that of an operator interested, in the capacity of consulting engineer, in the operation of public utilities, and still again that of the electrical contractor, having spent considerable time in that business a number of years ago.

The operator devotes much effort to increase the sale of electrical energy through elaborate window and store displays, commissions to employees, monthly-payment plans, display advertising and house-to-house canvasses. The ELECTRICAL WORLD has been of great assistance to the business in stimulating interest in this development.

The consulting engineer has recognized the growing demand for electricity and has kept pace with this development by educating clients in the advantages of modern appliances and of outlets ample in number and capacity to take care not only of present demand but of possible future needs. Consulting engineers have designed feeders and sub-feeders of such capacity as would give proper service under increased demand. The ELECTRICAL WORLD has again materially aided such efforts to lighten the efforts of the operators in their sale of electrical devices.

The electrical contractor, however, needs education along the line of co-operation. In his efforts to get business he destroys the confidence of the public in the operator and consulting engineer and the entire electrical profession.

He frequently condemns the equipment sold by the operator as being inefficient in comparison with equipment which the contractor himself sells, and he does not base his statements on any tests or accurate information. He frequently condemns the operator's sales efforts, not realizing that these efforts are helping to increase his own business. He frequently condemns the design made by consulting engineers in order to suggest a reduction in number or capacity of outlets or a reduction in feeders and sub-feeders, thus enabling him to make a reduced price, though not one commensurate with the actual saving in material and labor, and thus permanently limiting the use and sale of energy-consuming devices together with the labor of installation. The electrical contractors go so far as to look upon the engineers as competitors in their endeavor to make designs for architects for which they receive little or no pay.

These same contractors frequently go to the owners instead of the architects when they find that some other contractor has made a design and suggest that the other contractor is a favorite of the architects and that no one else will get a fair deal in the architect's office. At times this may be true, but such condemnation again destroys confidence in the entire profession.

When contractors make designs it occasionally happens that, for example, they call for an excessively long run of heavy feeders where a much shorter run is possible, or lead-covered cable is specified where none is required, and then they submit bids on their own specifications, offering a reduction in price on the change to a correct design. Such practice is neither clever nor consistent with good business.

There is no reason why a contractor should not make designs if he receives compensation for them, but generally he could devote his whole time more profitably either to designing or to contracting, but not to both. When he does make the design it is more ethical not to submit a bid on it, as the dual position of contractor and engineer is as difficult to fill successfully as is the dual position of general contractor and architect.

The electrical contractors need to adopt a code of ethics similar to those of the Rotary Club and other professional and business organizations. The ELECTRICAL WORLD could be of material assistance in educating the contractor to seeing the possibility of an increase in business to himself and to the consulting engineer, manufacturer, jobber, dealer and operator if he would co-operate in the encouragement of more liberal but not extravagant design.

The contractor could materially assist in educating architects and builders in the employment of consulting engineers for the proper design of electrical installations, and thus avoid what is at present the unnecessary and unprofitable burden of free designs by the contractor.

Co-operation is the keynote of expansion and continued success of the entire electrical industry.

HERMANN C. HENRICI.
Henrici-Lowry Engineering Company,
Kansas City, Mo.

Size of Automatic Stations

To the Editors of the ELECTRICAL WORLD:

From time to time a question is asked as to the maximum size for which an automatic station or an automatic substation can be recommended. This question is becoming more prominent as the economies shown by automatic stations come to be appreciated by operators. It is one to which a specific answer cannot be given, since in each case the maximum size depends upon the circumstances. As a matter of fact, the maximum size of an automatic station presents no technical difficulties. The size is in almost every case limited by the financial considerations. For example, no one questions the installation of a 2,000-kw. automatic railway substation or a 5,000-kw. automatic hydro-electric station. However, it would be questionable if any one would recommend installing a 200,000-kw. completely automatic station.

An analysis of the problem makes it apparent that the dominating factor in the maximum size of an automatic station is the relation between the attendance charges and the fixed charges based on capital investment. Where the attendance charges are high compared with the fixed charges a complete automatic station is, in practically all cases, warranted. Where the attendances charges are only a relatively small percentage of the fixed charges complete automatic operation does not seem warranted.

It may be seen from this review that there is no fixed maximum limit for the size of an automatic station, but that this limit is one dictated largely by financial parameters.

CHESTER LICHTENBERG.
General Electric Company,
Schenectady, N. Y.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Telephony Over Power Lines in Europe

SATISFACTORY communication is being conducted over high-voltage power lines in Europe on at least a dozen systems. Use is made of a carrier frequency superimposed on the low-power frequency, and the transmission line and ground are employed to complete the oscillatory circuit. The cost per station is from $3,000 to $4,000, and some of the important installations are:

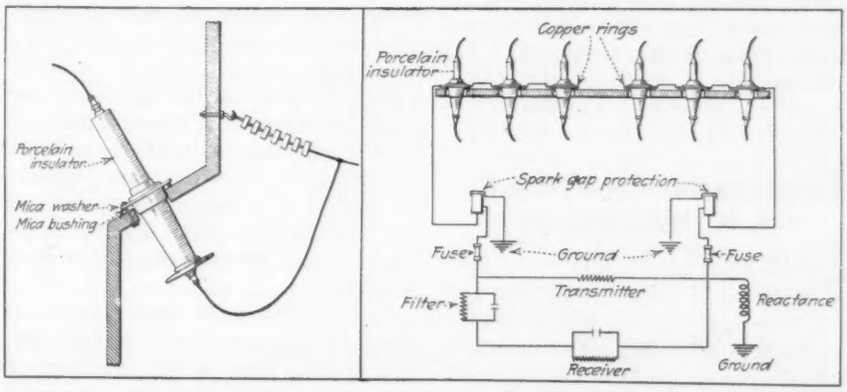
Country	Location	Distance, Miles	Voltage
Germany	Golpa-Rummelsburg	90	110,000
Germany	Hirschfelde-Dresden	60	110,000
Germany	Harbke-Nachterstedt	30	50,000
Switzerland	Geneva-Lusanne	45	55,000
Sweden	Untra-Vartan	90	110,000
Norway	Aarlifoss-Skien	50	65,000
Norway	Askim-Kristiania (Toien)	50	65,000

One of the first installations was that between the Aarlifoss Power station and Skien, Norway, a distance of 50 miles. Each station has a 10-watt transmitter, receiver, calling apparatus, switchboard with provision for automatically charging the storage battery and a 600-volt motor-generator. All this apparatus is in the room where the transmission lines lead out, while the telephone transmitter and receiver are on the desk of the engineer in charge of the station. By lifting the receiver off the hook the tubes are lighted, the motor-generator is started, and high-frequency waves are sent out which operate a relay in a resonant circuit, causing a bell to ring. When the receiver at the distant station is raised the bell is disconnected, tubes are lighted and the motor-generator started. Different wave lengths are used for transmission and reception, namely 1,560 m. and 1,720 m., so that two-way speech is possible.

Coupling the apparatus to the high-tension lines was a difficult problem. At first wires were strung below the lines as far as the first or second tower from the station. This construction did not give desirable results, however, as the capacity between the coupling antenna and ground was much larger than between the antenna and the transmission line, resulting in considerable loss.

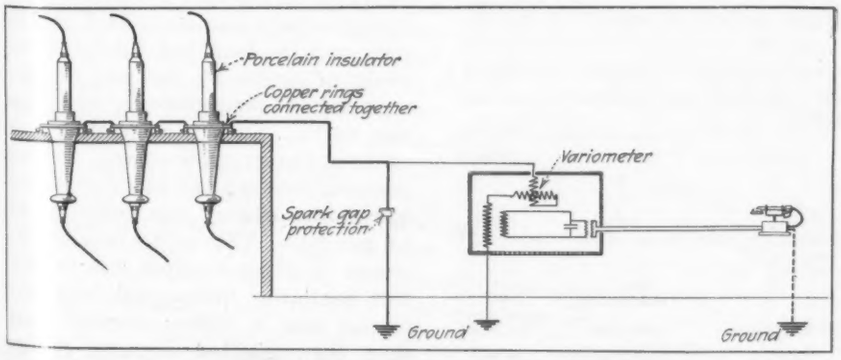
At the present time roll-paper condensers are used between the carrier-current apparatus and transmission lines operating at voltages up to 75,000. In the system between Aarlifoss and Skien and that between the transformer stations at Askim and Kristiania (Toien), which were only recently installed, these condensers have an outside diameter of about 3 in. and a length of about 4 ft. Two of these are connected in series and are tested at ten times transmission voltage so as to insure protection to as great a degree as possible from high voltage on the telephone apparatus. Additional protection is secured by means of a spark gap with low break-down voltage and large current-carrying capacity (200 amp. at 2,000 volts to 3,000 volts), fuses and insulation of the open oscillating circuit of the apparatus from the closed oscillating circuit.

With high voltage (80,000 to 110,000) the cost of condensers becomes prohibitive and the danger from high voltage increases. At these voltages the coupling is made by means of a copper ring concentric with the entrance insulator at the building wall. Since there is a voltage of approximately 100 between this ring and ground, it is insulated from the wall by three porcelain insulators. Where there is only one three-phase line, the rings around the three entrance insulators are connected together and used as coupling capacity to the transmission line. In this case the ground is utilized to complete the



EVEN WITH TRANSMISSION LINE BROKEN OR GROUNDED INTELLIGIBLE CONVERSATION IS POSSIBLE WITH CARRIER CURRENT SYSTEM

Left—Coupling of telephone apparatus to 110,000-volt line by means of copper rings around center of bushing. Right—Coupling apparatus for two 110,000-volt lines.



COUPLING OF TELEPHONE APPARATUS TO A 110,000-VOLT TRANSMISSION LINE AND GROUND

oscillatory circuit. Where there are two transmission lines capacity rings are used on the second line instead of a ground return.

This system of telephony has marked advantages over ordinary line telephony in that it is only little affected by even large disturbances on the transmission line. Even with one or two conductors of a line broken or grounded, it is possible to carry on intelligible conversation. When the system was first installed at Aarlifoss and Skien, interesting tests were carried on to see to what extent the line could be damaged and communication still possible. The two stations are connected to the same conductor, and there are two three-phase lines. Not only was the conductor to which the stations were connected broken, but the whole three-phase line was broken and grounded in three places, and it was still possible to communicate.

CLIFFORD N. ANDERSON,
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Comparative Cost Data for A.-C. Substations

SOME preliminary cost data have become available for purposes of comparing automatic and manually operated substations. These figures should be of interest to any one considering the installation of automatic stations. The difference in the cost of construction for the stations cited in the accompanying tables is not marked, though it should be noted that their capacities are not on a strictly comparable basis.

Operating expenses, however, vary in a marked degree, those of the lowest-cost manual station being from five to ten times those of the two automatic stations per kilowatt-hour handled, while the two remaining manual stations multiply these differences by from two and one-half to three.

Regarding the design of automatic substations, provision is made in must cases for a liberal duplication of transmission facilities from sources of supply as well as duplicate transforming equipment with a complete spare unit in reserve. Protective and control equipment for incoming lines and transformers is usually adapted for multiple or unit operation of lines or transformers, or both, this being supplemented with added protection against overloading and overheating of transformers.

One of the most important features to be considered in any station of this type is the selection of switching equipment of adequate capacity to meet successfully any conceivable emergeny.

Perhaps the most radical departure from usual practice in manually operated stations is the almost universal elimination of double high-and-low-tension buses. The newer construction includes either no high-tension bus and a single low-tension bus or sectionalized single high-and-low-tension buses with manually operated non-automatic switches installed between sections for emergency use.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

COST OF ALTERNATING-CURRENT SUBSTATIONS

	Automatic Station, A	Manual Stations 1	2	3
Designed capacity	12,000	10,000	10,000	6,000
Installed capacity	6,000	10,000	6,000	4,500
Cost per kva. installed capacity	$30.00	$26.00	$26.00	$33.00
Estimated cost per kva. at full rated capacity	24.00	26.00	20.00	28.00
Estimated ultimate cost per kva. at full rated capacity with spare transmission line and transformer	32.00	.....	.....	.....
Estimated cost of self-restoring equipment for circuits and additional cost of high-capacity oil switches over those regularly used in manually-operated stations per kva. of rated capacity	Approx. 3.50	.....	.....	.....

OPERATING AND MAINTENANCE COSTS OF AUTOMATIC ALTERNATING-CURRENT SUBSTATIONS

Station Equipment	Station A*	Station B
Incoming—13,200-volt lines	3	2
Outgoing—13,200-volt lines	1	1
Outgoing—2,600/4,500-volt, four-wire overhead and underground circuits	6	3
Transformers (self-cooled and water-cooled), three-phase, kva	three 2,200/3,000	One 3,000/5,000
Street-lighting equipment	0	0
Output, 1921—kw.-hr	24,647,700	4,300,090 (6 mos.)
Station operating and maintenance cost, cents per kw.-hr., 1921	0.0219	0.0105

* Station A operated with part attendance.

OPERATING AND MAINTENANCE COSTS OF MANUALLY OPERATED SUBSTATIONS

Station Equipment	Station 1	Station 2	Station 3
Incoming 13,200-volt lines	5	3	3
Outgoing 13,200-volt lines	4	2	3
Outgoing 2,300/4,000-volt, four-wire overhead and underground lines	16	7	6
Transformers, three-phase, kva	Two—3,000/5,000 Two—1,750 One—500	Four—1,500	Three—1,500
Street-lighting equipment	0	Six C.C. transformers	Four rectifiers Two C.C. transformers
Output, 1921—kw.-hr	16,661,000	5,964,000	5,728,000
Station operating and maintenance cost, cents per kw.-hr	0.1063	0.2598	0.314

Better Voltage Regulation Increases Output

A SEVERE loss of business due to low voltage was suffered by a power distribution company serving three towns with a combined population of 1,500. This company bought all of its energy from a transmission company. The writer was called upon to estimate the reduction in output due to the low voltage and to suggest means for correcting this trouble. The solution of this problem brought out some facts which it is thought will prove of general interest.

No reliable records of the power demand and voltage being available, the necessary data were secured by the installation of a curve-drawing voltmeter and a wattmeter. The records for a single day are shown in the accompanying illustration. The regulation is seen to be very poor, about 15 per cent. The peak load is 120 kw. and the load factor about 40 per cent. The load was supplied over a single-phase line of No. 6 B. & S. copper, 30 miles long, at 13,200 volts.

Having the load curve and the voltage curve, the load curve can be corrected to what it would have been if the voltage had been held at 120 volts and the load had consisted entirely of lamps by the use of the lamp-voltage-lamp-power consumption curve. Such a correction was made, as shown in the curves. Taking the area between the two curves, the increase in energy was found to be 5.5 per cent. This is the possible increase in gross receipts due to perfect regulation unless peak load customers pay a higher energy rate than the weighted average energy rate of all the customers. The fig-

ure represents also the loss of gross income under the conditions of poor regulation. This figure will vary from day to day as the load varies with the changing seasons.

The yearly loss must be estimated from the daily load charts. In the case under consideration the conditions on the day tested were assumed to hold for a six-month period and the loss was neglected for the next six months.

A study of the load curve indicates overlapping of the power and lighting loads at 5:30 p.m. Any discrepancy in the calculations due to assuming that the entire evening load is caused by lamps will be counterbalanced by the error due to assuming that there are no lamps or heating devices in operation during the daytime. The morning peak, between 7 and 7:30, is probably due to lamps and heating appliances.

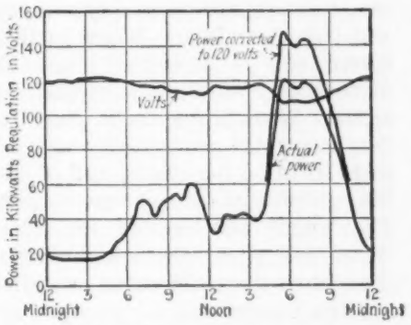
VARIOUS METHODS OF CORRECTION

Knowing the magnitude of a loss in revenue, every manager wishes to know how the loss may be reduced and how much the reduction will cost. Voltage losses can be reduced by increasing the size of the copper composing the transmission line or can be overcome by installing regulators. An examination will now be made as to the relative cost of each of these methods. In order to have the discussion concrete, the following assumptions will be made: Cost of generating station and transmission line, $175 per kilowatt capacity; annual gross receipts, $50 per kilowatt of peak load at full voltage; annual operating expenses, 70 per cent of gross receipts; cost of coal and water, 50 per cent of operating expenses. The load curve given is the average load curve encountered in small towns.

The only increase in expenses caused by having perfect regulation will be that due to the increased coal and water used. A 5.5 per cent increase in energy sold will therefore cause a 3.6 per cent increase in receipts after deducting the cost of the increased coal and water used. This will increase the net income available for payment of fixed charges and dividends by 12 per cent or $1.80 per year per kilowatt of peak load. The actual increase may be greater than this, because under prevailing rates the increased energy consumption is largely due to residence customers, who pay the highest energy charge.

Doubling the wire will cost in this case about $30 per kilowatt and decrease the regulation to half its former value, neglecting the voltage drop in the line transformers. This will result in an increase in income of 90 cents per kilowatt, or 3 per cent on the additional investment to the property.

The regulation can also be reduced to half its former value by adding a wire and making the transmission line three-phase at an expenditure of about $20 per kilowatt. This will result in an increase in income of 90 cents per kilowatt, or 4.5 per cent on the additional investment. A regulator can be installed for about $11 per kilowatt, resulting in practically perfect regulation and securing an increase in net income of $1.80 per kilowatt, or 16 per cent on the additional investment.



INCREASE IN ENERGY CONSUMPTION DUE TO BETTER VOLTAGE REGULATION

The reduction in the line-resistance losses by installing larger copper or making the line three-phase will make a better showing for these methods of improving the regulation. The cost of the losses in the regulator will cause a poorer showing to be made by the regulator. The superiority of the regulator will still hold good, and the voltage regulation will be better when a regulator is used.

One utility manager reports an increase in business of 10 per cent during the year following the installation of voltage regulators. It has been common experience that complaints as to rates being high usually follow a lowering of the standard of voltage regulation. No electric power company can therefore afford to get along without a fairly comprehensive voltage survey being made often enough to determine whether the regulation is satisfactory on all parts of the system.

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No Dangerous Strains from Sudden Steam Discharges

NO DEGREE of shock whatever was shown when the effects of large sudden steam discharges from boilers were investigated by the American Society of Mechanical Engineers' research sub-committee on sudden initial pop lift of safety valves. The results obtained by this committee, of which P. G. Darling is chairman, were presented at the recent annual meeting of this society. The tests were conducted to determine whether there is a shock to the boiler which under any condition may become dangerous or cause damage when a relatively large steam discharge is suddenly released or such a discharge from a boiler is suddenly stopped, as in the opening and closing of a safety valve.

The tests covered sudden steam discharges which in size, relative to boiler capacities, were far in excess of the capacity of any safety valve which would ever be attached to the boiler. With a 75-boiler-hp. Almy water-tube boiler at the plant of the Crosby Steam Gauge & Valve Company at Boston (actual test in this case being made by the Massachusetts Institute of Technology) the maximun discharge tried was approximately three times the total safety-valve requirement of the A. S. M. E. Boiler Code. On a 94-boiler-hp., 300-lb.-pressure Babcock & Wilcox boiler installed in the plant of the Consolidated Safety Valve Company at Bridgeport, Conn., more than seventeen times the total valve capacity for the boiler was instantaneously relieved in the attempt to produce a shock. When it is considered that two or more valves would be called for by the A. S. M. E. Boiler Code, the sudden steam relief that was tested at Bridgeport would be thirty-four or more times the largest valve which would generally be used with this boiler. The locations of the pressure indicators in the Bridgeport test, selected because considered the most likely points to receive shock, are believed to be representative enough to justify the conclusion that no shock would be detected from an attachment at any other place.

In the opinion of the committee the investigation might be continued with prolonged trials on different types of boilers under different conditions of steaming, and with additional points of attachment for the pressure indicators. However, con-

sidering the fact that no degree of pressure increase or shock whatever was detected under the severe steam-discharge conditions tried, the committee believes that it is extremely unlikely that any boiler conditions would be found so radically different as to produce a shock. In other words, if a pressure-increase shock could be produced by any reasonable boiler operation, the committee believes that the conditions of their tests were representative enough to insure detection of such shock.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Combined Red and White Safety Isle Fixture

TO SECURE the proper functioning of safety isle lighting units, it is necessary that they be of a character easily seen both in daytime and at night. While a red globe placed at the top of a pole in the center of the zone has certain advantages in that when the light is on it may be clearly seen, it is open to the objection that the base of the post is not sufficiently lighted. These illuminating fixtures can be installed for a small portion of the cost of illuminated signs for the same purpose and the maintenance cost is practically negligible.

The objection has been entirely overcome by the simple and inexpensive fixture shown in the accompanying illustrations and employed by the South Park Commission in Chicago. A number of these fixtures have been tried out for some time at busy intersections on Chicago's boulevards and have been found very satisfactory. A translucent globe is used in place of the usual expensive ruby globe. The fixture for the lights on multiple circuits consists of a conical metallic reflector constructed in two parts which is assembled after being placed within the translucent globe. The globe in turn is carried on a four-lamp cluster supported from the globe holder below. This is shown at the bottom center. The cluster is arranged with two ruby incandescent lamps above and two clear lamps below as illustrated and is supported from the globe holder at a predetermined position. When the globe is placed on the holder the assembled shade adjusts itself on the cluster and divides the globe into two compartments. The upper position of the globe shows red while the lower portion illuminates the safety zone surrounding the fixture.

Day and night views of a safety isle equipped with the fixtures are shown on the left and right of the illustration. A number of the fixtures are proving very satisfactory as boulevard crossing signals. In this case the fixture is used on the regular series boulevard lighting standards (top center), the lamp cluster being replaced by the use of a ruby-glass inverted bowl inclosing the upper part of the standard series tungsten lamp. The reflector is supported from this ruby-glass bowl. The illuminating effect of the street light is not affected by the installation of the fixture as only the upward rays are utilized for creating the red signal.

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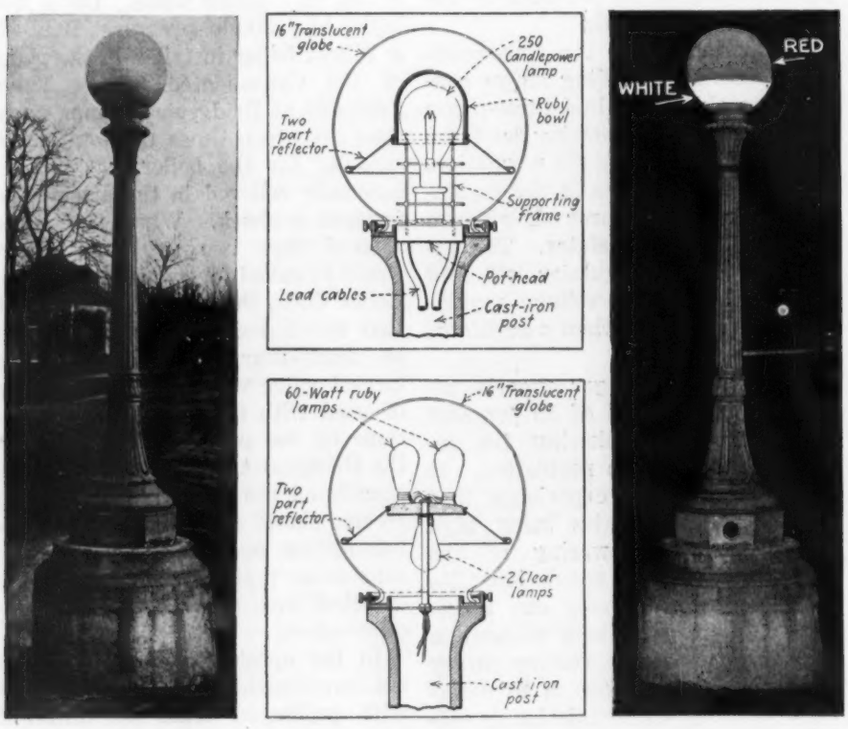


ARRANGEMENT OF BOULEVARD CROSSING AND SAFETY ISLE LIGHTING FIXTURES USED BY SOUTH PARK COMMISSIONERS IN CHICAGO

The white light from the bottom of either fixture, as shown in center, illuminates the lighting standard and prevents automobile drivers from running into it. The top of each globe is red and gives the driver warning of the presence of the standard. Day and night views of the safety isle fixture are given on either side.

Standard Busbar Ratings Adopted

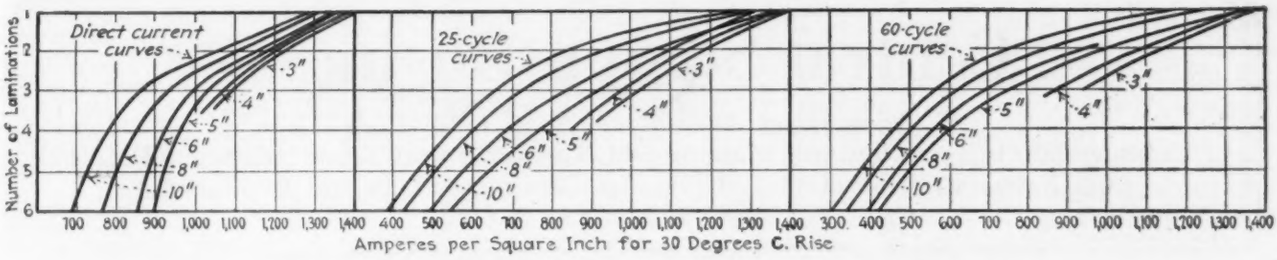
CERTAIN revisions of the rules on application and rating of busbars and connection bars have been developed by the Power Switchboard and Switching Equipment Section of the Electric Power Club and adopted as standards at the fall meeting of the club at Asheville, N. C.

The standard now specifies that all busbars shall be rated on a basis of temperature rise instead of current density. The current-carrying capacities of the usual sizes of copper buses, based on a 40 deg. C. ambient temperature, are given in the accompanying curves. These curves are to be used for currents not exceeding 3,000 amp. The spacing between laminations is $\frac{1}{4}$ in., each lamination being $\frac{1}{4}$ in. thick. A spacing of 8 in. is left between phases. Slightly increased capacity is obtained by replacing each $\frac{1}{4}$-in. lamination with two $\frac{1}{8}$-in. laminations and using $\frac{3}{8}$-in. spacing because of the increased radiating surface. However, this advantage is gradually offset by increased inductance as the number of laminations increases per phase and as the spacing of phases decreases.

The standard practice in the rating and application of busbars and connection bars as revised is as follows:

On account of the variation in radiation, skin effect and reactance due to the arrangement of busbars, ampere ratings of bus and connection bars shall be based upon temperature rise instead of on a constant-current density.

A contact pressure of 250 lb. per square inch shall be the minimum for good engineering practice in



CURRENT-CARRYING CAPACITY OF THE USUAL SIZES OF COPPER BUSES BASED ON 40 DEG. C. AMBIENT TEMPERATURE

bolted or clamped connections of bars.

All contact surfaces of buses and connections shall be cleaned by sandpapering or other suitable means immediately before bolting.

On account of the low temperature at which the oxidization of copper commences a maximum operating temperature of 70 deg. C. shall be used in the design of copper buses and the connections thereto, except that on extended bus systems isolated from apparatus where unusually heavy contact pressure is employed at joints and connections a maximum temperature of 80 deg. C. may be used.

FIELD EDITOR ELECTRICAL WORLD.
Chicago, Ill.

Meter Testing Aided by Use of Test Panels

TO FACILITATE the testing of large power meters, provide greater safety for the tester and comply with the new electrical safety order of the Industrial Accident Commission of California, the Southern California Edison Company has developed and standardized a plug-type meter-testing panel. Most power companies in California use the over-all or primary method of testing their meters, which introduces complications on account of the difficulty of connecting the testing equipment into the circuit without interrupting the customer's service.

The panel shown in Fig. 1, with meter and relay mounted, is neat and inexpensive and by means of the test receptacles provides a ready means of testing the meter in a minimum of time and with greater safety to the tester. A small panel retained by wing nuts and sealed covers the plug receptacles, except when the meter is being tested. This type is constructed on one panel, the main-line switch being installed elsewhere. Fig. 2 is a rear view of this same panel, showing the method of installing the receptacles for connection to their proper line and load wires for three-phase installations.

Another standard test pane is shown in Fig. 3. In this type the meter, main-line switch, test panel and motor-starting compensator are all mounted on the same angle-iron frame. The wiring diagram shown in Fig. 4 for use with this panel indicates the connections for testing the meter either with phantom load or using the customer's load. A large percentage of meters are tested with the customer's load, making it unnecessary to isolate the meter for phantom-load testing. Such cases are those of pumping plants, refrigeration machinery, etc., where the load is fairly constant.

The two installations described above are made up to and including 440-volt service. With voltages above 440 and up to and including 2,300, a special test panel is used. The method in primary testing is similar to that heretofore described, with the exception that no phantom loading is attempted unless a water rheostat is available and is used for test load.

A still further development in test equipment is found in the diagram shown in Fig. 5. This type of installation is used mainly in substations and for the larger customers who take 10,000-volt or 15,000-volt delivery. Provision has also been made in this type of installation for connecting the testing equipment into the circuit without interrupting the customer's service. By opening certain of the switches shown all connections may be made to the dead end of these switches with safety to the tester.

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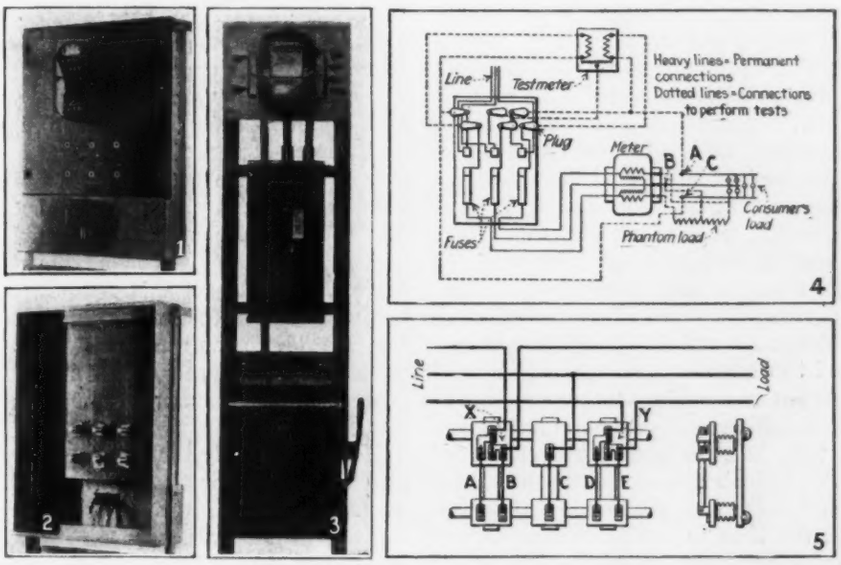


NEAT AND INEXPENSIVE PANELS PROVIDE MEANS OF TESTING METERS IN MINIMUM OF TIME AND WITH SAFETY

Fig. 1 — Plug-type meter-testing panel adopted by Southern California Edison.

Fig. 2—Rear view of panel shown in Fig. 1, showing method of making connections.

Fig. 3—Test panel in this type of installation is mounted in connection with main-line switch. All wiring is in conduit.

Fig. 4—Testing consumer's meter with phanton load without disturbing the load; wiring diagram for panel shown in Fig. 3.

Fig. 5—Connections for 15,000-volt test switch. Under normal conditions of operation all disconnecting switches are closed as shown. When cutting in for testing purposes, switches *A*, *B*, *C*, *D* and *E* are opened and connections are made on the lower terminals. After connections are made, the switches *A*, *B*, *C*, *D* and *E* are closed and *X* and *Y* are opened, cutting in the testing equipment, after which the test may be made with safety.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Commercial Problems for 1923

Need of Organizing New-Business Departments for More Efficient Operation and the Training of Suitable Salesmen Principal Causes of Concern

CENTRAL-STATION new-business managers are confronted by a number of outstanding commercial problems which must be worked out during the year 1923. In the order of their importance these problems may well be grouped as bound up in: First, improved new-business organization; second, training competent salesmen; third, a definite merchandising policy with an accurate method of cost keeping; fourth, careful planning for a selective development of business in the territory; fifth, closer attention to the quality of residential wiring and to the adequacy of store lighting; sixth, proper allocation of expenditures for advertising and the promotion of new business; seventh, development of electric transportation.

Central-station executives, after their war-time experience with power shortage, are unanimous in the belief that new business of a highly diversified character should be built up. However, they feel that the old pre-war policy of "new business for the sake of additional load" will not fit present-day conditions. Consequently, while new business should have a load-building value where it involves the sale of energy-consuming devices, these sales should be made at a profit and this particular branch of the commercial department must be put on a self-suporting basis. The possibilities of commercial development, judging by the past growth of the industry, are almost unlimited, and it is generally believed that now is the time to put sales departments on a firm and lasting basis.

New-Business Organization

Of first importance, naturally, is the question of departmental organization. The work of the central-station sales department may be divided into two general heads—(1) selling energy or load building, and (2) selling energy-consuming devices at a profit, or merchandising. While the two are intimately related, it is important that their activities be kept distinctly separate in order that accurate records may be kept of what each accomplished.

Load building involves the sale of energy from which profit will be realized, and the cost of such commercial operations should be charged to the promotion of the business. Much more thought is needed as to the kind of business which it is most profitable for a company to go after, and while this is governed to a considerable extent by the industrial nature of the community, it is essential that a company know just what the power, commercial and residential potentialities of its territory are. Therefore a survey of the territory to show where new customers can be taken on and how the loads of existing customers can be increased is necessary in order to lay out a fitting sales program. Large power and commercial customers will not be overlooked because of their size, but it is easy to underestimate the value of the many smaller users of energy which make up the real bulk of the business. In order, though, to reach out and get this prospective business, it is necessary for the central station to maintain actively at work a force of salesmen who can represent the company in the territory.

Here is probably the most puzzling problem of all for the new-business manager. There are not many central-station salesmen or representatives left. During the war many of them went into other fields, and those that remained have, through their added experience, now become rather highly specialized in some particular line—power, industrial heating or illumination—or else they have gone with a smaller company as commercial manager. This makes it necessary to find and train an almost entirely new lot of salesmen. This was considered sufficiently difficult in former days, when an old, experienced salesman could take a new man out and break him in, but now it must be met in some other manner. For a while it seemed that it would be possible to obtain salesmen by advertising for canvassers, in the belief that it would not be necessary for these men to know very much about the electric light and power business. This has not worked out well because the caliber of the men who present themselves in answer to advertisements is low. They cannot be classed as other than peddlers, and the turnover in salesmen is exceedingly high. Only by sifting all applicants carefully can any really good salesmen be found. The ratio of salesmen retained to the total number employed during a year runs as high as one in twenty in one company.

Selecting Salesmen

However, the situation is by no means hopeless, and a solution is being found by several companies in employing as salesmen only the highest grade of men they can find. It will be necessary to offer higher compensation in some cases, but this will be offset by the fact that more conscientious men are obtained. This practice has several advantages. Men with better selling experience will be attracted to the central station. They are men who will gain knowledge of the business more quickly and will not, as a rule, require so long a training period nor so much supervision. They will be steadier because they are not looking for a stop-gap job for a few months. For the most part, they want a permanent place, and where the remuneration is sufficient they can be counted on to stay.

The matter of finding younger men to train as salesmen presents a somewhat different problem, for quite often they are not sure that they want to remain in the central-station business, and even so they may not be adapted to the selling end. Some companies are solving

this question by taking on a certain number of young men each year in a cadet capacity as they graduate from high school or college, and by giving them about three months' experience in each of the different departments the kind of work for which they are best suited is determined at the end of a year or eighteen months. By reason of this practice those who reach the commercial department will make very capable salesmen.

SALESMEN'S COMPENSATION

One thing more which will seriously affect the question of finding the right men for salesmen is the methods of compensation. Probably no two companies use exactly the same basis for paying salesmen. Methods vary, the most usual forms being flat salary with no commission, salary plus commission, drawing account with commission and straight commission. Some companies have tried out all these forms of compensation and have yet to determine which is the most satisfactory. This lack of uniformity is a serious handicap in developing and retaining permanent sales forces, and a more nearly standard method could well be adopted. A set rule, of course, could not be used by all companies, but in making up a schedule of compensation two important elements should be considered. First, commission or salary should be proportionate to the value of the business, and, second, the salesman should receive compensation sufficiently liberal to keep their enthusiasm from lagging from month to month. Opportunity for advancement is one other element, aside from actual compensation, which will go far in holding a sales force together and keeping men on their toes.

The problem of merchandising is an interesting one. Whether or not the central-station company shall merchandise electric appliances may depend upon the local situation. But the fact that some companies which discontinued their appliance-sales departments are now reviving them on a larger scale than formerly indicates that it is advisable in many instances for the central station to show the way in merchandising practice. In all such cases the business is to be conducted along ethical lines, with a view to making a profit.

To do this merchandising must be made self-sustaining. Its cost of operation must be kept entirely separate from other commercial activities, and it should not look for or expect financial support from the company because of its load-building value. This is not only poor business for the company, but it is a form of unfair competition with other legitimate electrical dealers.

When a company has definitely decided to go into merchandising it must carefully analyze the local situation with reference to the location of its store to the best advantage. The electrical store itself or appliance salesroom, as the case may be, must be equipped as a real store and not be merely a makeshift display room as an adjunct to the cashier's window where customers pay their bills. Furthermore, if the central-station company would make a profit from its merchandising, it must learn to be a merchant. Costs of doing business must be kept accurately and stocks and turnover must be most carefully watched so that leaks may be stopped. The idea that should be kept ever foremost is that the business is being conducted to make a profit.

In developing the fields for new business the central station should not devote attention to one class of business at the expense of another. Where this has happened in the past it has not been intentional, for after the lighting load had brought about the high daily peak it became imperative that a day load be found, and after the power load got under way it grew so rapidly that in 1920 it came near swamping the electric light and power companies. Therefore in the future it is advisable to keep some semblance of balance between the lighting and power loads because of the well-known advantages of diversity, particularly diversity in revenue in times of industrial depression.

RESIDENTIAL LOAD

The possibilities of additional lighting business are only just now being fully appreciated. In the residential sections many companies measure their degree of success by the number of customers connected, and they feel that the increasing number of meters indicates that they are rapidly approaching the point of saturation and must look to other fields for more business. However, it is pretty generally admitted that the lighting of the average home is inadequate, that the sale of appliances is hampered by the lack of a sufficient number of outlets, and that a campaign for the education of the public to a more complete use of the service must be made.

Electrical homes will prove of enormous value in stimulating public interest and new homes will be wired properly. But the educational work,

Electric Heating May Exceed Motor Load

THE rapid development of the electric heating load is typified in this large oven for baking enamel on automobile fenders. The oven is 12 ft. wide, 8 ft. high and 134 ft. long and has a demand of 450 kw. Heating engineers maintain that there exists in every industrial plant manufacturing processes which can be made more economical through the application of electric heat. They also predict that this load will, in the not very distant future, exceed the motor load by a ratio of between two and three to one.

particularly as to old costumers, cannot stop there. It should be carried to them by the central-station salesmen, through direct mail and newspaper advertising and by practical demonstrations of home lighting. If residential customers are to be profitable customers, they should be fairly generous users of energy, and to this end the value of adequate wiring for better lighting and the utilization of appliances should be fully impressed on them by the company. This is one of the big jobs that the central station must learn to do.

COMMERCIAL LIGHTING

Store lighting also still offers an opportunity for load building no less than that offered by home lighting. In fact, it has been proved that only 30 per cent of the stores in an average city have adequate lighting. This class of business is quite often at the very door of the central station, and it is not difficult to demonstrate to a merchant the value of good lighting. Therefore the central station can to advantage develop one of its salesmen as an illuminating engineer who can perform a distinct service for commercial lighting customers and at the same time build up a highly profitable load for his company. The problem here is first to develop the salesmen and then to implant in the minds of the merchants an appreciation of the profit value of a high standard of illumination.

HEATING AND MOTOR LOADS

Power business is coming more easily to the central station because of the admitted economy of central-station service as compared with the isolated plant, but it must not be forgotten that this is largely the result of years of tedious missionary work on the part of the power salesman. In that time he has developed the personal confidence of his "prospects" in what he says and in the company back of him and now we see the results of this work. With the increasing motor load the field of industrial electric heating is developing, and the most optimistic heating engineers expect that this load will soon overshadow the motor load by a ratio of three to one. In this field again the power salesman must carry on his personal campaign of education until he establishes the confidence of the skeptical "prospect," when the business will come on the lines with perhaps greater rapidity than the power business. This kind of industrial business always means long pull ahead and needs sympathetic and patient support from central-station executives.

Closely allied with the power business is the growing popularity of the electric vehicle in the field to which it is adapted. So far the central-station company has not been able to give the proper attention to electric transportation because so many other things appeared to demand attention first. The great obstacle has been inertia in taking hold of the electric vehicle and doing a real selling job. But there is an opportunity for team work and co-operation between the central-station men and the vehicle and battery manufacturers. The prob'em depends much, however, on the establishment of suitable service facilities.

In many of its new-business operations the central station has what might well be termed traditional handicaps to overcome. It has long been the policy to conduct the sales department with the sale of more energy as its main purpose. If a deficit was shown, it was charged to promotion of the business. But the development of the industry has reached a point where the new-business department should be able to pay its own way. Central-station executives and commercial managers recognize this and are bending their efforts in that direction. Several definite changes in policy will go far to bring it about.

First, there must be a fundamental change in the philosophy of these departments; that is, the aim should be to merchandise for profit, not for the sale of energy. Second, there should be an improvement in the technic of retail operation to include proper cost figures with more sales per dollar of operating expense. Third, there should be adequate margins of profit. Fourth, there should be greater efficiency in spending money for promotion, advertising and other new-business expense. Fifth, there should be established a stable and permanent commercial organization which will not change with the seasons. Sixth, there should be a careful analysis of the local territory with the view to planning a definite sales program which will then be religiously adhered to.

What Some Companies Did in 1922

New-Business Activities Which Marked the Commercial Reawakening of Central Stations Generally in All Sections of the Country

AT THE beginning of 1922 a strong upward swing in business was under way, and the year as a whole was characterized by solid, consistent improvement along commercial lines in the central-station industry. This condition was by no means confined to any particular section or group of states, but rather the quickening of business activity was general and uniform throughout the country.

The revival in merchandising extended all over the Eastern and New England States and the experiences of individual companies is typical. The Massachusetts Lighting Companies had the best year in appliances in its history. The Worcester (Mass.) Electric Light Company's merchandise sales to Dec. 1 totaled $109,119, against the entire 1921 total of $110,731. The increase over 1921 to the above date was $17,463, and the holiday trade was expected to carry this gain far ahead. Appliance sales in the Tenney companies have been running about double those of last year for months, and in some cases even better. Electric radiators, vacuum cleaners, hollow ware and irons have moved in great volume. The Boston Edison Company alone sold 1,600 radiators after August. The Pittsfield (Mass.) Electric Company opened a new appliance store on a main thoroughfare late in the fall, with excellent results. In communities served by non-merchandising central stations, like Fall River, Springfield and Greenfield, Mass., business for electrical dealers shared in the incoming tide of prosperity. The electric shop of the Narragansett Electric Lighting Company, Providence, R. I., did a land-office business in appliances in the year just closed.

Store-lighting activity developed in many communities almost into a race among competitive merchants and neighboring manufacturers to install modern illumination at higher intensities. In Boston the Bureau for Better Illumination rounded out the year with a total of two thousand visitors, and its work will be continued in 1923. A great wave of new business is now sweeping in as a

result of the educational work of this bureau. A number of New England central stations are planning to do intensive work in illuminating engineering this year, and the demand is active for men trained in this specialty.

With better industrial conditions power sales have risen rapidly of late. By Feb. 1 one customer of the Bristol & Plainville (Conn.) Electric Company will have increased its demand from 3,000 kw. to 6,000 kw. Seven hundred horsepower in shoe factories alone has lately been installed by the Haverhill (Mass.) Electric Company. Industrial electric heating developed steadily during the year at Hartford, Manchester, Worcester, Boston, Springfield and other places in New England. Small-plant betterment work absorbed a large connected load in new motors throughout this district. In Providence an industrial electric heating store was opened during the year, this being probably the first of its kind in the United States. Power business developed in the Montpelier, Vt., district, and the diversified service of the Central Maine Power Company increased substantially. Conditions improved much during the year among the power customers of the leading hydro-electric companies.

Industrial electric trucks and tractors were in improving demand in 1922, as manufacturing conditions strengthened. Electric road trucks sold slowly until about Sept. 1, when a turn for the better occurred which has been well sustained and which makes the 1923 outlook better than for many years.

House Wiring in New England

There were so many wiring campaigns in New England in 1922 that space will not permit more than a brief reference to them. The Tenney companies' plan allowing two years to pay was most successful. The Central Maine Power Company put through an intensive campaign resulting in 2,214 contracts in five weeks. The Worcester Electric Light Company obtained two and one-half times as many house-wiring contracts in 1922 as in 1921. To Nov. 1, 1921, the company took on 523 new house-wiring customers, representing an outlay of $82,769 and the installation of 1,121 new meters. At Providence, in Salem, Fitchburg and Malden, Mass., in Boston and many other places the past year's activity in house wiring has been striking.

The Elmira (N. Y.) Water, Light & Railroad Company continued its policy of increasing the residential load by the sale of domestic appliances and by the end of the year expected to add something over 1,000 kw. by this means. The value of such a load is shown by the fact that the company's income from its residential customers has been 20 per cent greater than in 1921.

At Norfolk, Va., the Virginia Railway & Power Company concentrated its efforts on ice and cold storage plants, with the result that it has contracted for 3,000 kw. additional, which will bring the company's refrigeration load to 5,000 kw.

Central and Southern Companies

In the Central and Southern States the commercial activity was no less marked. The Commonwealth Edison Company's appliance sales in Chicago have increased and the outside selling force has been augmented until there are now 150 salesmen working from the company's trucks. Their sales for the year will total over $1,000,000. The Duluth (Minn.) Edison Electric Company is employing two lighting salesmen who are constantly calling on commercial lighting customers with excellent results.

The Union Gas & Electric Company continued its house-wiring campaign in Cincinnati and expected at the close of the year to have contracted for wiring 20,000 old houses as compared with 17,000 in 1921. This company retired from merchandising several years ago, but has again gone in for the sale of electric appliances stronger than ever and has leased a building for this purpose.

The New Orleans Public Service Incorporated has given particular attention to building seasonal business where needed to balance its load and has taken on a very profitable raw-water ice-plant load. This company has also established an electric vehicle department which has already produced very satisfactory results in increased business. The Consumers' Electric Light & Power Company, also operating in New Orleans, has pursued a merchandising policy with a view to load building and earning a profit and has conducted active campaigns to increase its commercial lighting load and the sale of electric appliances. This company is now making a survey of all customers to ascertain what appliances they are using and to interest them in further use of the service.

In the West and on the Pacific Coast also there has been a marked growth in the appliance business. In some sections this amounts to an increase of 40 per cent over the business done in 1921. This is attributed primarily to the convenience-outlet campaign which is beginning to show real results from the publicity work of the past few years. The California Electric Co-operative Campaign now recognizes other channels than the electrical dealers in the merchandising of appliances as a large percentage of the sales are through the department, hardware and furniture stores.

The possibilites of commercial lighting have become apparent and a survey of a large number of stores made by the California Co-operative Campaign during the past year indicated that the intensities varied from three-quarters of a foot-candle to 18 foot-candles, showing the necessity of intelligent illumination work. One merchant in a large California city, who a year ago made an investment of $10,000 in window lighting, finds that adequately illuminated show windows are the best means of advertising and selling and in moving to another location has ordered wiring, fixtures, lamps and other equipment costing $25,000. The Co-operative Campaign is now constructing a portable window-lighting exhibit which will be taken from place to place, and special merchants' day programs will be put on.

Western Power Development

In power there has been a steady, natural development. In the Northwest there has been a noticeable increase in the use of electric drive in the lumber industry because of its great economies and flexibility. In California there are now three thousand wells being pumped with electric motors on the lines of one central station alone. There has also been a healthy increase in electric pumping for irrigation.

The California Co-operative Campaign will lay particular stress on education within the industry and education of the public. Ten electrical homes will be shown during the year. These will be in charge of high-class demonstrators who will be thoroughly competent to "sell" the electrical idea. Particular stress is to be laid on the use of electric ranges and water heaters. Ten illuminated billboards will be erected on the main arteries of travel of the state to tell the message twenty-four hours a day.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Operating Features of the Montville Power Station.—Numerous instruments and carefully kept records have aided in maintaining high operating efficiency in this 20,000-kw. plant of the Eastern Connecticut Power Company. A comprehensive description is given of the coal-handling methods, feed-water preparation, boiler operation, equipment and transmission and distribution systems. Several typical log sheets used at this station are included.—*Power Plant Engineering*, Dec. 15, 1922.

Calculation of High-Pressure Penstocks.—A. HRUSCHKA.—If the methods suggested by different authors for calculating penstocks for hydro-electric plants are compared, many contradictory details will be found which, if followed, will result in widely differing data. The author has therefore studied the different methods, has eliminated what appeared to him faulty and has compiled a comprehensive collection of data and formulas upon which to calculate the forces in a penstock and to design the penstock. Two main classes of penstocks are being used, the axially movable type, with anchors in the form of stuffing boxes or dilatation joints, and the solidly anchored pipe-line type, without dilatation joints but with yielding elbows at points off the straight path. The many individual forces occurring during the operation of a penstock are mathematically investigated, and finally their combined action, as it manifests itself at the anchors of the pipe line or in the elbows, is calculated. The proper dimensions of the cement blocks or pillars supporting the line are given from an investigation of the mechanical forces exerted by the line upon these points. The present boom in the erection of hydro-electric plants, especially in countries lacking an adequate coal supply, makes this elaborate treatise especially timely.—*Elektrotechnik und Maschinenbau*, Nov. 12 and 19, 1922.

Generation, Control and Switching

Cooling of Turbine Generators.—A. R. SMITH.—A difficulty in thoroughly cleaning the air used for cooling turbine generators has led to the introduction of the recirculating system. The various methods for cooling the air when recirculated are discussed in this article, which compares all systems of generator cooling from numerous standpoints. With the direct system it is possible to discharge the air into the boiler room and burn it. With the indirect system using surface coolers it is possible to absorb all or part of this heat by circulating the condensate through the surface cooler.—*General Electric Review*, December, 1922.

Air Flow in Electrical Machinery.—C. J. FECHHEIMER.—The manner in which a vapor flows is one of the most important and perhaps the most difficult of the problems of mechanics. Only recently have quantitative solutions been obtained for certain cases, and these have come with the advent of the aëroplane, by use of which studies have been successfully made. An attempt is made to describe the laminar and turbulent flow of air in electrical machines, and a few applications are described.—*Electric Journal*, November, 1922.

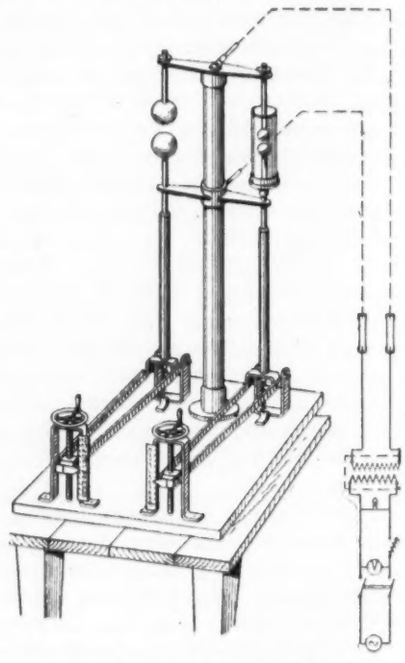
Transmission, Substations and Distribution

Modern American Practice on Power Transmission.—Y. FUKUDA.—A review article showing the progress made in America in high-voltage transmission. The author also deals with the Boston-Washington Superpower Zone, backwater suppressor, low-head, high-speed water turbines, automatic water plants, the use of aluminum cables, insulators for extra-high-voltage transmission, electric vehicles, electrification of steam railways and load-dispatching and plant-inspection methods.—*Journal of the Institute of Electrical Engineers of Japan*, November, 1922.

Electric Power in Iron and Steel Works.—A. DAVIDSON.—The author gives a user's opinion on the question of alternating current versus direct current in iron and steel works. He claims that direct current is not suitable for all purposes, and the choice is, therefore, between alternating current for the large motors, with direct current for the small motors, and alternating current throughout. In either case three-phase generation should be used. The finances of the possible schemes are discussed, and the last is shown to be the cheapest. Certain technical questions, such as speed control, power factor and frequency, etc., are dealt with, the author showing that he supports the alternating-current system.—*Electrician*, Nov. 24, 1922.

Units, Measurements and Instruments

Oil-Testing Apparatus.—I. ESTORFF.—It is customary to measure the dielectric strength of oil for oil switches or transformers with a fixed spark gap inserted into a sample of the oil, raising the voltage on the gap gradually until breakdown and reading the tension on a voltmeter. To insure reliable test data a pure and undistorted sinusoidal voltage must be used to feed the transformer. What appears to be a simpler apparatus is described in this article. Instead of a fixed spark gap, an adjustable gap is used, the movable electrode being arranged at the short end of a ten-to-one lever. Turning a handwheel on an insulated spindle increases or decreases the distance between the sphere electrodes, placed one above the other in a glass vessel containing the oil, and indicates at the same time their distance. This feature does away with the necessity of a gradual increase of the voltage and obviates, therefore, the regulator or the variable choke coil. To be independent of the form of the voltage wave, a second sphere gap with 50-mm.



RELIABLE DATA GIVEN BY THIS OIL-TESTING APPARATUS (I. ESTORFF)

balls is arranged in parallel with the gap under oil and operates in air. A similar lever mechanism regulates the distance between these spheres. This oil-testing apparatus will, according to the author, give reliable data on any supply-line circuit. — *Siemens Zeitschrift*, November, 1922.

Measuring the Rotary Magnetic Hysteresis Losses.—TETSUTARO MIYAZAKI. — Many investigations into rotary magnetic hysteresis have been made, but the results show a great discrepancy. This is thought due to the errors of various measuring methods as well as the difficulty of separating the hysteresis losses from the masking effects. Instancing the irregularity of the electromagnetic field brought into existence by the unsymmetrical forms of test pieces, the author describes a comparatively accurate method consisting of measuring the torque of a solid spherical test piece in a rotary magnetic field.—*Journal of the Institute of Electrical Engineers of Japan*, November, 1922.

Illumination

Illuminating Engineering Society Papers.—The December issue of the society's transactions contains several papers presented at the Swampscott (Mass.) convention. The first two papers are "Overcoming Daylight Reflections in Show Windows," by Ward Harrison and H. T. Spaulding, and "The Effect of Light on the Drawing Power of the Show Window," by Walter Sturrock and J. M. Shute. Abstracts of these two papers may be found in the convention report on page 759 of the Oct. 7 issue of the *Electrical World*. A tentative draft of a code of luminaire design drawn up by the committee to co-operate with fixture manufacturers (M. Luckiesh chairman) is a third paper. An attack upon the problem of glare from the angles of visual acuity and shade perception is the basis of research undertaken by a sub-committee on this subject, headed by Louis Bell, which submitted a report. Abstracts of these papers may be found on page 761 of the Oct. 7 issue of the *Electrical World*. A complete discussion of all the papers is included in the transactions.—*Transactions of the I. E. S.*, December, 1922.

Motors and Control

Equalization of the Energy Demand in Coal Mines and Rolling Mills.—T. STEIN.—The difference is pointed out between energy variations of the minute and of the hour character as regards duration, and it is shown how they originate and how they affect the operating machinery. An equalization of the minute variations is accomplished by the steam capacity of boilers, by exhaust-steam accumulators and by flywheels. A live-steam accumulator permits the equalization of hour variations for both the heat generation and the heat demand. Their use may result in coal economies of from 10 per cent to 15 per cent. A number of diagrams show steam and electric connections for different operating conditions, and the most suitable electric machines for these systems are described.—*A. E. G. Mitteilungen*, October, 1922.

Heat Applications and Material Handling

Electrical Developments in Iron and Steel Works.—JAMES SMITH.—The author reviews recent developments in the use of electricity in iron and steel works. He deals with lifting and handling appliances. Details are given of modern cranes, magnets, shunting locomotives, charging machines, stripping machines, plate-handling devices and excavating appliances. The electrical equipment used for driving and controlling these machines is described.—*Electrician*, November, 1922.

Standards for Resistance Welding Transformers.—For this special class of machinery it is essential that careful consideration be given to the viewpoint of the manufacturer, user and central-station man, in order that a rating may be arrived at which will be equitable to all. For this purpose the sub-committee on rating of welding machines of the American Welding Society has proposed standards for resistance welding transformers. These standards include continuous rating, intermittent rating, classification of insulating materials, method of loading transformers in temperature tests, input tests under load conditions, no-load and load losses, efficiency, power factor, voltage, insulation and nameplate rating.—*Journal of the American Welding Society*, November, 1922.

Electrophysics, Electrochemistry and Batteries

Spectro-Photo-Electrical Sensitivity of Argentite.—W. W. COBLENTZ.—An investigation made into the effect of crystal structure upon photo-electrical sensitivity as observed in two crystal forms of silver sulphide, argentite and acanthite. Experimental data are given on the effect of temperature, of the intensity of the radiation stimulus and of mechanical working of the material upon the spectro-photo-electrical sensitivity of argentite. These observations are then compared with similar data previously published on acanthite. From a comparison of the reactions of these two crystal forms of silver sulphide under various conditions it appears that the crystal structure has a marked effect upon photo-electrical sensitivity.—*Scientific Paper No. 446 of the Bureau of Standards.*

Traction

Electric Locomotives for South African Railways.—A short article giving briefly an account of the seventy-eight locomotives which have been ordered for the South African Railways for the electrified section of the main track between Glencoe and Pietermaritzburg, a distance of 171 miles. These locomotives are designed to haul passenger and freight trains over the electrified area and are so arranged that they can be worked alone or with other locomotives in multiple-unit operation.—*Electrician*, Nov. 17, 1922.

Paris-Orleans Railway Electrification Is Progressing.—The large number of locomotives which have been ordered for initial installation will be largely of French make, but America will furnish the control equipment. Details of the control equipment and the rigid test to which they were put are described.—*Electric Railway Journal*, Nov. 4, 1922.

Telegraphy, Telephony, Radio and Signals

General Equations of a Balanced Alternating-Current Bridge.—VLADIMIR KARAPETOFF.—Owing to the developments in the art of electrical communication and to the improvements in the sources of high-frequency sinusoidal currents, the use of the Wheatstone bridge for the measurement and comparison of inductances and capacities has increased considerably. For this reason the author deduces a general equation of the alternating-current bridge which would comprise the various actual bridge arrangements of any specific case. These formulas have enabled new bridge arrangements to be devised without deducing fundamental equations or constructing vector diagrams.—*Philosophical Magazine*, November, 1922.

The Wave Filter and Its Inductance Coil.—A theoretical and experimental investigation concerning wave filters with the view of studying their properties and the conditions under which they can attain maximum efficiency, especially in the case of radio receiving instruments. An ideal filter ought to transmit smoothly within a definite range current of any frequency with minimum attenuation. However, because of resonance effect between the filter and receiving instruments, and further because of the attenuation of the filter being variable, depending upon the impedance of the receiving instrument, the wave amplitude of the receiving current fluctuates with the frequency within the range. In causing a band-wave filter in which one factor—either inductance or capacitance—is omitted to transmit completely a wide range of frequencies it is difficult to suppress abruptly currents of frequencies lying just outside either limit of the intended range.—*Researches of the Electrotechnical Laboratory*, Tokyo, Japan.

Miscellaneous

Helpful Relations Between the College and the Industries.—R. L. WALES.—To present a fairly complete analysis of the problem the author has assembled facts and suggestions concerning it. In training men to be of service to the industry, the end in view, the personal qualifications of the student, the courses of study, the duration of the training period and the character of the instruction are controlling factors. The problem may be analyzed from two points of view, one considering the possible contributions of the college to industrial success and the other the reciprocal relation of the industries to the college. The duty of the college is to supply adequately trained men for the various phases of industrial leadership and operation and to serve as a center of information to which the industries may turn for assistance in the solution of technical problems. In training industrial leaders the need is suggested for stressing fundamentals rather than specializations through a type of teaching that develops in the student the habit of getting down to simple rock-bottom principles. Besides supplying trained men, the colleges may be of the greatest value through their organization for consultation and research. The industries in turn may help by impressing on the students the reality of engineering and the usefulness of engineering training.—*Engineering Education*, November, 1922.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

A Seven-Mile Power Cable

Great Western Company to Lay 11,000-Volt Submarine Cable Under San Francisco Bay

WHAT will, it is said, be the largest and longest submarine power cable ever installed will be laid across San Francisco Bay about Jan. 10 by the Great Western Power Company, at a cost of approximately $500,000, to bring additional hydro-electric power into San Francisco and to make possible a reduction in the amount of electricity it has been necessary to generate in the company's steam plants. The cable will be approximately seven miles in length and will be laid from the south end of Brooks Island, near Richmond, to Pier 41 in San Francisco. It will be an 11,000-volt, three-conductor, 500,000-circ.mil cable capable of transmitting 10,000 kw.

Because of the unusual size of the cable it was shipped from the factory of the American Steel & Wire Company coiled on gondola freight cars instead of on reels. Gondola cars of the largest capacity obtainable were used, and the cable was shipped in 4,800-ft. lengths, nine cars in all being required. The entire length of 38,500 ft. of cable will be coiled in circular pancake-like coils on a special cable-laying barge with all splices made, so that the submarine conductor may be laid in one continuous operation. It is estimated that about seven hours will be required for laying the cable. This is the method employed in laying transoceanic cables, but it is the first time it has ever been used for laying a long submarine power cable.

Washington Court Reaffirms Phillippay Decision

The decision of the Supreme Court of the State of Washington in what is known as the Phillippay case (see ELECTRICAL WORLD for Aug. 12, 1922, page 345), denying damages to a telephone company for inductive interference from a power line of the Pacific Power & Light Company, was unanimously reaffirmed by the court on Jan. 2. In this case the court held that the prior occupancy of a highway by the telephone company did not give it the right to collect the cost of metallicizing its line from the power company when the latter's transmission lines were properly built.

In reaffirming its decision the court said: "The statement in the opinion of the department to the effect that priority in time does not give a superior right seems to have caused some alarm. Let it be said that this statement must be read and understood as applying only to the facts of the particular case."

Public Ownership Man Put on California Commission

Four appointments by Governor Stephens of members of the California State Railroad Commission have just been announced. Clyde L. Seavey, city manager of Sacramento, was appointed for a term of six years to succeed H. Stanley Benedict of Los Angeles, whose term expired on Jan. 1. The other appointments were Harley W. Brundige of Los Angeles, now president of the commission, to a four-year term to succeed the late Harvey D. Loveland; Egerton Shore, member of the State Board of Control, to a four-year term to succeed Chester H. Rowell, resigned, and James T. Whittlesey of San Francisco to the unexpired two-year term of Mr. Brundige.

The appointment of Mr. Seavey, who is a strong advocate of public ownership, was a surprise. Seavey was one of those instrumental in framing the water and power act defeated at the state election in November and was active in its support.

Pacific Gas & Electric Rates to Be Reduced

A new schedule of rates for the Pacific Gas & Electric Company has been ordered by the California State Railroad Commission, effective Feb. 20. The new schedules are based on a valuation of $109,723,695. This valuation has been placed upon the properties of this large California utility, serving twenty-seven counties in the central and northern part of the state, after an investigation by the commission lasting over a period of nearly two years. The company claimed a valuation of $170,711,271 as a basis for rate-making purposes. In determining the valuation the commission followed its practice of using the historical reproduction cost method.

Under the new schedules lighting rates will be reduced about 12 per cent, power rates generally will be reduced about 10 per cent and a uniform schedule will be made applicable to all parts of the system.

Rates for San Francisco are fixed so as to do away with discrimination between competitive districts of the city.

The decision was handed down on Dec. 30.

Coal and the Utilities

J. W. Lieb and Others Tell the United States Commission the Facts of the Situation

A PRESENTATION of facts regarding coal supplies to public utilities during and since the war was made to the United States Coal Commission at Washington on Wednesday of this week by John W. Lieb as chairman of the joint fuel committee of the three national utilities associations. All the members of the commission were present.

Mr. Lieb said that because of the depletion of normal coal reserves public utilities would approach April 1 virtually dependent upon coal received on their contracts and such as might be purchased in the "spot" market. He declared that a strike would result in inability of the utilities to supply electrical energy, gas or street-railway and interurban transportation. Statistics regarding the three utility industries represented were given showing the extent to which the public depends upon their services. The suggestion was made that the commission should consider the feasibility of requiring railroads and mines to develop some method of coal storage. It was also suggested that consideration should be given to the feasibility of backing up the utilities' coal contracts with strict priority orders. A third suggestion was that a method be worked out whereby utilities may be assured at all times of coal complying with specifications regarding heat-unit content, volatile content, low ash content, etc. Suggestion also was made as to the desirability of a method whereby coal producers would offer attractive seasonal prices and operators attractive seasonal freight rates, in order to encourage storage of coal not only by public utilities but by others consuming large quantities. Many additional facts were stated by Mr. Lieb, who was questioned at length by members of the commission regarding all phases of the electrical industry.

Following Mr. Lieb's presentation special statements regarding the three industries and their problems were made by O. H. Fogg for the American Gas Association, Judge C. L. Henry for the American Electric Railway Association and M. H. Aylesworth for the National Electric Light Association. Chairman Hammond of the commission requested that specific data be furnished to the commission regarding matters brought out. The commission will report to the President on Jan. 15.

Smith for Home Rule

Favors Constitutional Amendment to This End and Sweeping Changes in Commission Law

GOVERNOR SMITH of New York in his inaugural message at Albany this week made recommendations for "home rule" of utilities and sweeping changes in the public service commission law along the lines which have been predicted and have already received much publicity. He also made a declaration in favor of state development, ownership and control of water powers, postponing specific advice on this matter till later in the legislative session. On the regulation of utilities he said in part:

"Probably no political principle has received so much statewide discussion as the question of a greater grant of power by the state to municipalities over such things as are wholly local. The cities of the state today, and particularly New York City, find themselves restricted by what is really a charter of limitation. The phenomenal growth of the cities brings up constantly for settlement new problems that the city should be left free to determine without interference by the state.

"The Legislature of 1921 passed an amendment to the constitution to bring this about which is now pending before your honorable body for passage the second time. If, in your judgment, this amendment accomplishes the purpose, it should promptly pass. If objections raised against it are of a minor nature it might be well to pass it any way and then start the legislative machinery again looking to further amendment that will cure any defect to which any real objection has been made. . . . Whatever action is taken on the present amendment at this session, I suggest for your consideration the initiation of a new amendment that would give to the communities of the state that full degree of local self-government which they are demanding and to which they are justly entitled. . . .

"Illustrative of this whole principle has been our treatment of the subject of control of public utilities. . . .

Attacks State Regulation

"The Public Service Commission of the state exercises regulatory powers over all public service corporations except railroads within the city of New York. In the fifteen years that have passed since the organization of the two public service commissions we have had fifty-four commissioners and the Public Service Commission has not yet succeeded in being much more than an object of political patronage. I think that I am within the truth when I say that the theory in itself never commanded a great amount of public respect. It makes little difference upon what you predicate it. The people in cities are unable to understand why the state interfered with the things that they believe to be local to themselves.

"In the last reorganization of the State Public Service Commission in 1921 the people of the state found that the control that they exercise over their own public utilities through their franchise agreements was taken away from them and vital portions of the contracts were nullified and the powers formerly exercised by the cities were transferred to the Public Service Commission. No defense can be made of this as it constitutes an absolute denial of self-government and home rule in the matter of contracts in all the cities of the state. The Public Service Commission is merely the agency of the state for the exercise of police power. There is no reason why the state should not select a municipality as its agent. To my mind we would get a better result.

"There are certain public utilities that are not within the confines of a single city, as their operations are either between cities or statewide. As to these utilities the state must retain its powers of control and regulation. It may also be that some of the cities of the state may be unwilling to assume the obligations of regulation. We must not force it upon them, as that would again constitute an interference with home rule. . . .

"In order to carry out this policy, the present Public Service Commission should be abolished and power given to the Governor to appoint not more than three commissioners to regulate such utilities as will not be regulated by the cities, either because they operate outside the corporate limits of a city or because the city may, by proper resolution, request the state to do it.

For Municipal Ownership

"I recommend that in the preparation of the legislation to abolish the present Public Service Commission the power heretofore held by cities over the terms of their franchises be returned to them, where it belongs. . . .

"Directly in line with this program

Delegates to the International Electrotechnical Commission Session at Geneva

4. Sir Richard Glazebrook (Great Britain).
5. Dr. Strecker (Germany).
6. Signor Semenza (Italy).
7. Dr. Mailloux (U. S. A.).
8. Colonel Crompton (Great Britain).
9. M. Boucherot (France).
10. Dr. Wheeler (U. S. A.).
14. M. Girault (France).
15. Colonel Gunton (Great Britain).
17. Mr. Hobart (U. S. A.).
18. Prof. Kloss (Germany).
19. Mr. Magalhaes (U. S. A.).
20. Mr. Cooper (U. S. A.).
21. Signor Barbagelata (Italy).
22. M. Belli (Switzerland).
23. Mr. Skanoke (Norway).
24. Mr. Rodgers (Great Britain).
25. Mr. Hunter (Great Britain).
26. Dr. Sharp (U. S. A.).
27. Mr. Meares (India).
28. Dr. Fleischmann (Germany).
30. M. Brylinski (France).
31. Mr. Good (Great Britain).
33. Mr. le Maistre (England).
34. M. de Montmollin (Switzerland).
36. Mr. Huber (Switzerland).
37. Mr. Roth (France).
38. Mr. Everest (England).
39. Mr. Hunziker (Switzerland).
40. Signor Vannotti (Italy).
41. M. Darries (France).
42. Dr. Sulzberger (Switzerland).
43. Prof. Morelli (Italy).
44. M. Dupont (Belgium).
45. Mr. Collens (U. S. A.).
46. Prof. Lorin (France).
48. Mr. Skinner (U. S. A.).
49. Dr. Rüdenberg (Germany).
51. Mr. Smith (England).
53. Gen. Harries (U. S. A.).
54. Mr. Doane (U. S. A.).
56. Mr. Rechniewski (France).

is the municipal ownership of public utilities. Public utilities have become so essential to the life of our great cities that the cities themselves should be permitted to purchase, build, own or operate them when a municipality determines this to be in its best interest."

Activities of Power Board

Loose Project Formally Disapproved—Advocates of Girand Plan Welcome Fall's Retirement

AS ANTICIPATED (see ELECTRICAL WORLD, Dec. 16, page 1349), the Federal Power Commission has formally declined the application of Col. C. E. Loose for a license covering a power project on the East Walker River, in California. This action insures the use of the reservoir site in question for irrigation purposes.

After investigation the commission has ruled that navigation will not be affected by the proposed development of the River Falls Power Company of Andalusia, Ala., which desires to erect a 30-ft. dam in the Conecuh River near Palsaliga Creek.

The questions involved in the use of the so-called Narrows site on the Ouachita River, 10 miles below Hot Springs, Ark. (see ELECTRICAL WORLD, Dec. 23, page 1407), will be considered at a hearing before the commission, which will be held probably in the week of Jan. 15.

THE GIRAND DEVELOPMENT

With Secretary Fall's retirement from the Cabinet announced for March 4, the proponents of the Girand development at Diamond Creek on the Colorado River are in hope that the new Secretary of the Interior will take a different stand on that proposal. It is believed that the Girand license would have been authorized had not Secretary Fall been in a position to block it. Mr. Fall wanted the government to construct the works necessary to the utilization of the waters of the Colorado River. The two other Secretaries who with him have composed the Federal Power Commission are understood to favor the Girand project so that the Arizona copper companies and other interests may have at the earliest time the power of which they are in such great need. The water-power act provides, however, that no license shall be granted for a project affecting any reservation of the United States unless the Secretary having administrative control sanctions the plan. In this case the Hualpai Indian reservation follows the south bank of the Colorado in the Diamond Creek area. This gave the Secretary of the Interior legal power to block the project single-handed.

In that connection an interesting development is the activity of the Southern California Edison Company at Glen Canyon, just above Lee's Ferry. It is understood that the California Edison has drilled that area and has found solid rock at levels which would be entirely satisfactory for dam foundations.

Street-Lighting Tables for 1923

FOLLOWING its practice for thirty-four consecutive years, the ELECTRICAL WORLD has prepared tables showing the proper time for lighting and extinguishing street lamps. The tables for 1923 are now ready, and a copy of them will be sent free to any subscriber upon request to ELECTRICAL WORLD, Tenth Avenue and Thirty-sixth Street, New York. For more than one copy a charge of 25 cents each is made to cover a portion of the postage, printing and compilation costs.

New York State Amends Its Plea on Power Act

The United States Supreme Court has granted the motion of the State of New York for leave to amend its bill of complaint and amended bill in the suit to test the validity of the federal power act and to restrain the Federal Power Commission from exercising jurisdiction over certain waterways in New York. In its amended petition the state claims that the exercise of alleged unlawful authority by the Federal Power Commission will subject the state to a multiplicity of lawsuits and deprive it of the constitutional right to handle affairs within its own boundaries when they do not affect other commonwealths.

Since 1903, the petition declares, the state has spent more than $200,000,000 on its waterways, and it is preparing to spend large sums for the development of navigation and for hydro-electric projects on the St. Lawrence, Mohawk, Hudson and Oswego Rivers. The state contends that its rights of ownership are challenged and that the Federal Power Commission is going beyond the regulation and control of waterways for the specific purpose of navigation. Such control, the state in its amended petition claims, is all that the water-power act sought to confer and the only authority that can be exercised properly by the Federal Power Commission.

Alabama Power to Take Over Montgomery Utilities

The two lighting companies of Montgomery, Ala., with the street-railway system and the gas service, are to be taken over by the Alabama Power Company as soon as the approval of the Public Service Commission is granted. Thomas W. Martin, president of the Alabama Power Company, has announced the purchase of the properties following the advocacy of the transfer by the Montgomery Chamber of Commerce and other local interests. No statement concerning the purchase price was made. The Montgomery Light & Traction Company and the Montgomery Light & Water Power Company, which own the electric light and power, street-railway and gas services of the city, have been administered by a court receiver for several years.

Negotiations for the sale were, according to announcement, begun some months ago by the Chamber of Commerce, as the result of inquiries from companies which desired to locate in the Montgomery district if adequate power at suitable rates could be obtained. W. F. Black, secretary of the chamber, said that some of these prospective industries had found that power rates did not compare favorably with those in other parts of the South. Mr. Black predicted that this condition would be changed if the Alabama Power Company obtained control, and as a result of representations made to the chamber in person by Mr. Martin and Vice-president R. A. Mitchell the members unanimously adopted a resolution favoring the transfer.

Role of the Engineer

Two Sections of American Science Association Devote Meetings to Its Consideration

ENGINEERING was represented at the Boston gathering of the American Association for the Advancement of Science last week in two of the many sections—Section K (social and economic sciences), of which Dr. Henry S. Graves of the Yale Forestry School is chairman, and Section M (engineering), of which the chairman is F. M. Feiker, vice-president McGraw-Hill Company, Inc. At a joint session of the two sections John T. Black, State Health Commissioner of Connecticut, spoke on "Conservation and Industrial Waste," and William S. Murray, New York, on "Conservation of Power." O. C. Merrill, executive secretary of the Federal Power Commission, and Gen. Harry Taylor, Corps of Engineers, U. S. A., were unable to present their papers because of badly delayed train schedules.

"The Place of the Engineer in Civilization" was the keynote of the meeting of Section M. Dr. Ira N. Hollis, president of Worcester Polytechnic Institute, led the discussion, instancing the factors of transportation and communication as vitally touching the activities of men in every walk of life and dwelling on the need for the engineer to make an analytical study of the facts governing the solution of present-day problems. A similar point of view was expressed by Harrington Emerson, who alluded, as did Dr. Hollis, to the engineer's control of the instruments of production. Dr. J. B. Tyrrell told of the growth of the mining industry in Canada. The paper of C. F. Scott, professor of electrical engineering at Yale, was read in his absence by Dr. D. C. Jackson. It dealt with new phases of

engineering education and pointed out that the large part played by engineering in modern life made it essential that the training of engineers be approached with a new viewpoint of the engineer's place in the community.

Contributions from several delegates laid stress on the contention that the next step in engineering is to relate the problems of the material advance in civilization to the human problems of civilization.

Philadelphia & Reading Plans Mine System

Five or Six Large Modern Electric Power Stations Are to Be Tied Together to Feed Coal-Mining Machinery in Two Pennsylvania Counties

ONE of the largest purely industrial electric systems in America, and probably the largest in the world devoted solely to coal mining, is planned by the Philadelphia & Reading Coal & Iron Company for the operation of its coal mines in Schuylkill and Northumberland Counties, Pennsylvania. It will eventually comprise five or six large modern power stations, tied together in one great system supplying power for the company's forty-odd operations, for the Pottsville shops and for incidental uses. The individual plants will generate from 15,000 kw. to 20,000 kw. each, and the total power will be at least 100,000 hp.

There will be 85 miles of high-tension line, carrying a current of 23,000 volts, and additional secondary mileage in the way of service connections and direct cables to the mine pumps. These pumps will operate without the voltage being reduced. Some of the pumping installations are already finished.

What the Development Means

The Philadelphia & Reading project will bring about the almost universal substitution of electricity for other forms of power in operating the company's mine and breaker machinery, and it also implies the elimination of seventeen engine-driven non-condensing power plants—sixteen at mines and one at the Pottsville shops.

Two modern electric plants which will be incorporated in the new system already are in operation—a 5,000-kw. plant at Good Spring and a 4,800-kw. plant at Locust Spring. These plants are tied together now in a system which runs from Brookside, in the west end of Schuylkill County, to Pine Forest, a little north of Pottsville, thence north to Indian Ridge, near Shenandoah, and thence west through the Mahanoy Valley to Locust Spring. Fifty-five miles of primary high-tension line is already built. A line is now under construction from Locust Spring to Bear Valley, west of Shamokin, and later a short link will run from Bear Valley to North Franklin at Trevorton, the extreme northwest of the Reading properties. Next summer a line will be run south from Pine Forest to Pottsville, to supply the shops, and another line will run from Pine Forest to Silver Creek on the east. At Silver Creek one of the proposed new plants will be built.

An additional extension from Indian Ridge to North Mahanoy and the territory now supplied by the old North Mahanoy plant will round out this high-tension network. The old electric plants will not be scrapped but will be retained as emergency units.

The great extent to which electricity is used by the Reading, even under the present system of isolated stations, is shown by the fact that it is now operating more than 100 miles of underground trolley line, has 140 electric locomotives in service, operates 106 electric pumps and charges about 9,000 electric lamps for miners.

The Good Spring plant, opened in June, 1919, was the first unit designed for the proposed new system, and it typifies in a general way what will be done at other plants. This station was placed at Good Spring because that point is central for the Tremont district, because ample supplies of barley coal were available at that colliery, and because Pine Creek, near by, supplied sufficient water for effective operation. The boiler plant and dynamo room are constructed of brick and steel. There are seven Stirling water-tube boilers generating 4,500 hp. and fitted with Coxe traveling stokers. Coal is supplied from overhead bunkers, which are fed by a conveyor line from a large bin, the bin in turn being supplied with coal by an aërial tramway running to the foot of the breaker. Ashes are disposed of by a flushing system which washes them into a large tank, whence they are hauled by a 20-ton car to the spoil bank.

The generating equipment consists of 5,000-kw. steam-turbine generators operating at a pressure of 150 lb. and condensing at a vacuum of 28.5 in. The condensers are of the barometric type.

Power is generated at 6,600 volts and conducted to an eleven-panel switchboard equipped with indicating and recording instruments for measuring electric current. It is controlled through oil circuit breakers and is distributed to the colleries in the Tremont district at a line voltage of 6,600. For long-distance transmission there is a transformer station which steps up the potential to 23,000 volts, and it is carried through the rest of the circuit at that voltage. At each colliery supplied from this high-tension line a transformer station is installed equipped for measuring and controlling the power consumption at that mine, the voltage being stepped down from 23,000 to 2,300 for colliery distribution. At present there are twenty-two transformer stations installed, having a combined capacity of 25,300 kw. Oxide film lightning arresters are installed.

Progress of Metric System

Substantial progress toward the wider adoption of the metric system in America was emphasized on Dec. 30 at the annual meeting of the American Metric Association in Cambridge, Mass., in connection with the national convention in the same city of the American Association for the Advancement of Science. Well-attended sessions were held at the Massachusetts Institute of Technology. Dr. George F. Kunz, New York, presided.

Dr. A. E. Kennelly emphasized the value of common units in applied science, in his address upon "The Metric System in Electrical Engineering." He described the metric basis of electrical measurements, pointed out the growing popularization of metric terms through radio and other channels, and predicted the ultimate general adoption of the metric system in the United States.

B. L. Newkirk, General Electric Company, Schenectady, N. Y., in a paper on "The Metric System in the Electrical Industry," reviewed the growth of metric measurements in the past half-century and pointed out that there is no hope of getting the non-English-speaking world to adopt non-metric units. If the world is to "get together" at all, it must be on a metric basis.

Superintendent Meyer of the American Bosch Magneto Company, E. A. Marsh, consulting superintendent American Waltham Watch Company, and T. H. Miller of the De Laval Separator Company reviewed the successful use of the metric system in their plants, and Walter Wood of Philadelphia emphasized its business-getting value in selling material to foreign countries. Howard Richards described the use of the metric system in the shops of France and Germany, as observed last summer.

Interest in the meetings was increased by the appearance of opponents who spoke on behalf of the Secretary of War, the United States Navy and industrial organizations that look with disfavor upon the general use of the metric system.

During its convention the American Association for the Advancement of Science reaffirmed its belief in the metric system and passed a resolution recommending the use of metric units by scientific men in all papers of a professional character, with non-metric units in parentheses.

Water-Power Control Issue Reappears in Maine

State development of storage reservoirs is expected to come up again for consideration at the next biennial session of the Maine Legislature, which convenes at Augusta on Jan. 8. It is understood that Senator Ralph O. Brewster of Portland will introduce a constitutional amendment giving the state the right to create and finance water-storage districts, build dams and establish reservoirs for power development, and that the measure will have the backing of Governor Baxter, long an advocate of this policy.

New Plant in Anthracite Field

East Penn Electric Company Expects First 50,000-Kw. Section of Its Power House at Pine Grove, Pa., to Be Finished This Summer —Extreme Simplicity a Marked Characteristic

THE first 50,000-kw. section of the East Penn Electric Company's plant at Pine Grove, Pa., which is four or five miles from the anthracite mines, will be completed about June or July. With a cooling pond and a regulating reservoir to conserve the flow of Swatara Creek, on which the plant is built, sufficient circulating water will be obtainable for a 300,000-kw. development, according to the J. G. White Engineering Corporation, which designed the plant. Among its chief features are its sectional development and its extreme simplicity, the object being to minimize the number of operators required. The station is laid out for 50,000-kw. extensions with the boiler aisles at right angles to the turbine hall, permitting the change of turbine and boiler sizes or even the use of powdered fuel. Although traveling-grate stokers are employed in the section now nearing completion, it is most likely that the extensions will use powdered coal and possibly larger turbo-generators.

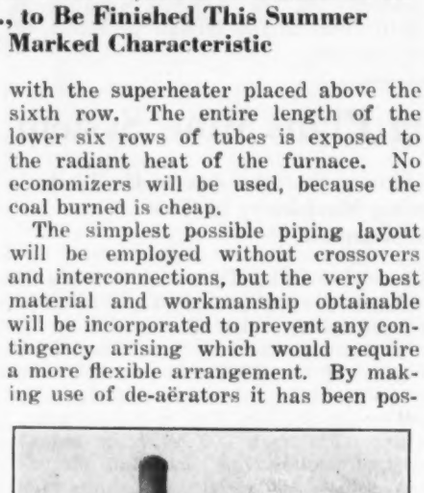
Anthracite "fines," containing 11,500 B.t.u. and 20 to 25 per cent ash, will be received by railroad and dumped into track hoppers, elevated to an outdoor overhead bunker at the end of the firing aisle and from there carried by means of weighing larries along the boiler-room aisle to the stoker hoppers. This arrangement has permitted the use of lighter steel in the boiler house. Outdoor storing and reclaiming of coal will be performed by a locomotive crane. The ash hoppers will dump directly into railroad cars. These cars as well as coal cars will be switched by steam-storage locomotives.

STOKERS AND BOILERS

Extra long (18-ft.) forced-draft traveling-grate stokers capable of operating at 300 per cent of nominal rating with natural draft are being installed with direct-current motor drive. The stack will be 350 ft. high. To relieve pressure on the furnace firebrick and also to facilitate replacement of sections, the furnace-wall facing is horizontally sectionalized by interlocking tile courses, each of which supports only six courses of firebrick.

Because of the limitation imposed by the width of forced-draft traveling-grate stokers available at the time of beginning the plant, it was considered economical to install boilers with only 8,000 sq. ft. of heating surface per unit, but they are arranged in batteries with ventilated walls between them, this ventilation being facilitated by the interlocking tile construction. Larger boilers can be used next time because wider stokers will be available. The boilers are designed for 300 lb. pressure and 600 deg. to 650 deg. total temperature and are twenty tubes high, with the superheater placed above the sixth row. The entire length of the lower six rows of tubes is exposed to the radiant heat of the furnace. No economizers will be used, because the coal burned is cheap.

The simplest possible piping layout will be employed without crossovers and interconnections, but the very best material and workmanship obtainable will be incorporated to prevent any contingency arising which would require a more flexible arrangement. By making use of de-aërators it has been possible to use wrought-iron feed-water pipes.



FIRST 50,000-KW. SECTION OF THE PINE GROVE (PA.) PLANT AS IT WILL APPEAR WHEN COMPLETED

The house turbines which supply all power for station auxiliaries are operated at such a load that their exhaust steam will maintain the feed-water temperature at 240 deg. constantly. Such operation is permitted by a tie-in transformer between the house generator and outgoing transmission line, containing a total of 20 per cent reactance, to prevent disturbances on the line interrupting auxiliary service.

Surface condensers with divided water boxes and two circulating pumps are employed, the latter being driven in such a way that they can operate on siphon feed or against spray-head pressure, or both.

FIRST GENERATORS RATED AT 12,500 KW.

Two 12,500-kw., 12,000-volt generators with direct-connected exciters and face-plate regulators will be used in the initial installation. The generators will be tied directly with 12,000/66,000-volt, three-phase transformers without intermediate circuit breakers or low-tension buses. Emergency excitation will be provided.

All auxiliaries except the stoker drives and part of the boiler-feed pumps are driven by alternating-current motors, the stoker drive being direct current and the non-electrical boiler-feed pumps turbine driven. The alternating-current drives will be supplied by 2,300-volt feeders, local substations and steel-inclosed control equipment. Most motors will be operated at 2,300 volts, but where a lower voltage is necessary transformers will be installed in the local substations. As mentioned before, the auxiliary service will be supplied by a 2,300-volt house generator from duplicate buses. Local substations will be provided for each turbo-unit to serve the circulating and condensate pumps and small house-lighting transformers, for the boiler-house auxiliaries and for the emergency exciters and miscellaneous equipment.

No signals except a general standby signal will be used between the main switchboard room and the turbine room. Instead, a loud-speaking telephone will be used in the switchboard room, while head sets with telephone jacks will be installed at convenient points around the turbines and auxiliaries. In addition to this equipment there will be an automatic intercommunicating system.

RELAY PROTECTION

Differential protection will be provided for the generators and transformers which will trip the main high-tension circuit breakers, the generator field switch and the neutral switch. Overload protection will not be provided for the generators except in the form of bell-alarm and signal indications on each generator. However, overload and balanced protection will be provided on the outgoing lines.

The 66,000-volt outdoor substation is very compact, this being made possible by a judicious use of a new design of motor-operated disconnecting switch throughout. Two double-circuit transmission lines will run from the substation to a 69,000/24,000-volt substation at Fishbach, Pa., where distribution will be carried on at 24,000 volts.

Boston Electrification Project Revived

Comprehensive plans for the electrification of railroads in the Boston metropolitan district will be discussed at a conference to be called early this month by Mayor Curley, following a report by Walter Stuart Kelley, an electrical engineer who has been investigating the subject for some time. Leading mercantile, transportation, financial and other interests, with the Department of Public Utilities and other public officials, will be asked to participate. Electrification of railroads and other improvements have been discussed before legislative committees and the public utility commission off and on for years, and it is hoped that through unifying public and official views progress may this year be made toward the ends so long recognized as desirable.

Boston Versus Cleveland

Electric Service Conditions in the Two Cities Compared in Massachusetts Rate Case

EXTENDED comparisons between the engineering and economic conditions affecting service costs were presented at a recent hearing in the Boston Edison rate case before the Massachusetts Department of Public Utilities by L. L. Elden, electrical engineer of the Edison Electric Illuminating Company of Boston. On behalf of petitioners for a reduction in Boston rates below the present maximum of 9.5 cents, considerable stress has been laid in these proceedings upon the 5-cent maximum rate of the Cleveland Electric Illuminating Company. Mr. Elden went to Cleveland a few weeks ago to study the plant and operating conditions there in this connection, and upon his return he presented an exhaustive analysis of the estimated effect of applying Cleveland conditions to Boston Edison operations, showing that were conditions comparable substantial reductions might be effected in the Boston rate.

The Boston Edison company's contention in this protracted rate case is that comparisons of operation among different companies are useless unless conditions are similar, and that where conditions are dissimilar differences in prices are not only justifiable but required. There are a number of fundamental differences between the Cleveland and Boston conditions. The Cleveland company, with a peak demand only about half as much again as Boston's, sells nearly twice as much energy. Within comparable areas there are about a thousand substantial industrial power customers at Cleveland against two hundred at Boston. The Cleveland company's load factor is higher, and because of the company's ability to sell large blocks of energy at high tension its distribution efficiency is much better than Boston's. Cleveland serves 293 square miles against Boston's 570, and the former has 30 per cent as much underground cable mileage to maintain as does the latter, approximately one-third as many miles of conduit and about half as many manholes. Boston has about twice as many poles to maintain, and the cost of overhead-line maintenance at Boston would be reduced by 45 per cent if Boston enjoyed Cleveland conditions. Twenty times as much street-lighting cable is in use at Boston, which maintains a 6.6-amp. street-lighting service against a 4-amp. service in Cleveland. Shorter circuits and fewer lamps per mile at Cleveland favor that company, as well as the use of 4,000 volts in street lighting compared with 6,000 volts and 8,000 volts at Boston.

THREE SUBSTATIONS TO ONE

Boston operates thirty-two substations against ten in Cleveland having attendants. If Boston's peak load could be handled within a Cleveland area, twenty-two substations could be eliminated and the attendance reduced from 238 to 60. Twelve storage batteries could be eliminated at Boston if Cleveland's output and Boston's peak could be handled in the Cleveland area on the basis of Boston operating costs. Boston furnishes lamps and renewals in its rate schedule; Cleveland does not. Cleveland supplies a very large high-tension output to street railways, whereas Boston supplies railways with low-tension energy, requiring additional investment in substations and equipment not needed by the Cleveland company. In many other features detailed in Mr. Elden's testimony it was shown that the "spread" between the two maximum rates of these cities was founded upon economic and engineering conditions.

The next hearing in the Boston rate case is scheduled for Jan. 11. In the meantime reports are current that the city authorities may conclude that with the realization of the voluntary and planned rate reduction program announced some months ago by the company as its goal it may be expedient to drop further proceedings before the commission.

Brief News Notes

Continental Company Buys Nebraska Utility.—The Continental Gas & Electric Corporation has contracted to purchase immediately the Lincoln (Neb.) Gas & Electric Light Company. President Rufus E. Lee of the Continental company is laying plans to make this newly acquired property the center of a large Nebraska system. Increases in plant capacities will be necessitated.

Houston Company to Expand.—The Houston (Tex.) Lighting & Power Company, it is officially announced, contemplates the erection in the near future of a power plant on the Houston Ship Channel to be known as the Deep-water station. The tentative plans call for an ultimate development of 150,000 kw. and the present installation of 40,000 kw. The plant is to be ready for operation early in 1924.

American Gas & Electric Acquires Ohio Service Company.—A controlling interest in the Ohio Service Company is reported to have been sold to the American Gas & Electric Company of New York by the United Service Corporation of Scranton, Pa. The new owner will, it is said, operate the Ohio Service Company, which serves many Ohio towns with electric light and power, in connection with the Ohio Power Company at Canton.

United Illuminating Company to Increase Stock.—The United Illuminating Company, New Haven and Bridgeport, Conn., has arranged for an increase of capital stock, issuing 9,805 shares at $100 par to stockholders, at the rate of one new share for each seven now held. The rights expire Jan. 20, 1923, and payments are to be made as follows: Twenty per cent by February 10, 40 per cent by June 10 and 40 per cent by Oct. 10.

Ohio Utility Financing Close to Million Mark.—Public utilities in Ohio sold $91,750,379 in securities during the first ten months of 1922, according to a report from the Ohio Committee of Public Utility Information. Distributed as to population, this means that more than $15 for every man, woman and child in Ohio was invested in additional capital for all classes of utilities. Of this total, the electric light and power utilities received $39,902,188, or 43.5 per cent. Most of the recent issues have been absorbed by the utilities' customers.

Electrification Project Between Dallas and Denton.—Engineers are now employed in working out the plans for the electrification of the 32-mile stretch of track of the Missouri, Kansas & Texas between Dallas and Denton, according to C. W. Hobson of Dallas, head of the Southwest General Electric Company. One of the changes on the line that will have to be made will be the installation of a block signal system. The electric interests will bear the entire cost of electrification, Mr. Hobson said, under the agreement with the railroad.

"Service at Cost" Proposed for Colorado Springs.—The franchise of the Colorado Springs (Col.) Light & Power Company expires early in 1923, and the company has proposed to the City Council that the city arrange to accept as a renewal of the franchise "service at cost," the city to distribute the electricity over its own wires. The City Council is deliberating upon further development of the Pike's Peak hydro-electric project, which, if fully developed at a cost of about $1,800,000, would give the city a municipally owned plant.

Consolidation in Washington State.—Arrangements have been completed for a merger of the Tacoma Gas & Fuel Company and the Puget Sound Gas Company with the Mountain States Power Company. All three companies are controlled by the Standard Gas & Electric Company, and President H. M. Byllesby states that their plants are modern and efficient and that the earnings of all of them should increase, slowly in the case of Tacoma and Puget Sound, but rapidly in the case of Mountain States Power Company. The properties are contiguous and are susceptible to the economies of unified management.

Consolidation Will Save $100,000 a Year.—The proposed absorption by the Interstate Public Service Company of Indianapolis of seven companies owned by the same interests that own the Interstate Company will reduce the fixed charges of the companies approximately 100,000 a year, Harry Reid, president of the first-named company, testified recently before the Indiana Public Service Commission. He said that the absorption would reduce by $1,848,106 the securities and debts now against the properties and that much better financ-

ing, more direct operation, less overhead expense and more scientific management all around would result from a merger.

Wisconsin University to Teach Meter Theory and Operation Again.—The University of Wisconsin will for the third time give a short, intensive course for electric metermen at the College of Engineering Laboratories, Madison, from Jan. 29 to Feb. 2. Questionnaires have been sent out to determine the qualifications of the men desiring to attend, in order to classify them into groups of equal experience. The work will be divided into five sections—indicating instruments, watt-hour meters, instrument transformers, demand meters, and miscellaneous work. A small fee will be charged. C. M. Jansky is professor of electrical engineering.

Transportation to Denver N. E. L. A. Meetings.—A special compartment car will be reserved for delegates from the East to the meeting of the Commercial National Section of the N. E. L. A. to be held in Denver on Jan. 24-26. This car will be attached to the "Lake Shore Limited" leaving New York by the New York Central route on Saturday, Jan. 20, at 5.30 p.m. and reaching Chicago at 4 p.m. Sunday. Sunday night will be spent in Chicago, and the car will be attached to train No. 9, over the Burlington route, leaving Chicago at 10.30 a.m. Monday and arriving in Denver at 3.30 p.m. Tuesday. The total one-way fare is $107.61. Reservations should be made at once through Clarence L. Law, chairman transportation committee, New York Edison Company, Irving Place and Fifteenth Street, New York.

St. Louis Utility Changes Name.—The Union Electric Light & Power Company, St. Louis, has been granted permission by the Public Service Commission of Missouri to change its corporate name to the St. Louis Electric Light & Power Company. The transfer of assets of the latter concern to the Missouri Electric Light & Power Company and the further transfer of assets to the new Union Electric Light & Power Company was also authorized. These changes are part of the reorganization and refinancing plan of the Union Electric Light & Power Company made necessary by the construction of its new Cahokia plant on the Mississippi River. Under a recent order of the commission, the authorized capital stock of the new company will be $25,000,000 preferred and 650,000 shares common stock of no par value.

Davis Bridge Dam Power House.—Work on the New England Company's Davis Bridge development is progressing rapidly. The dam will be 200 ft. high, about 1,200 ft. wide at the base and will extend across the valley of the Deerfield River for about 1,200 ft. The power house, to be built below Readsboro, Vt., will be about 60 ft. x 110 ft. in plan with a substructure of concrete located on a ledge and a superstructure of brick-steel construction. Since the power house will be about 150 ft. from the river bank, the tailrace is being excavated across the intervening flat, and the material is being used to grade the outdoor transformer and switching station area. Two vertical units of about 20,000 hp. each are to be installed first.

Lecture Course Planned by Oklahoma A. and M.—Plans have been completed for a series of eight lectures on public utility subjects to be delivered at the Oklahoma Agricultural and Mechanical College at Stillwater during the present school year. These lectures will cover various branches of the public utility industry and will be delivered by officers and executives of local utility companies. The first lecture was given on Dec. 11 by George A. Davis, assistant to the vice-president, in charge of public relations of the Oklahoma Gas & Electric Company. His subject was "What Is a Public Utility?" The other lectures are scheduled to be presented before the engineering school and the general student body. This service has been started by the speakers' bureau of the Oklahoma Utilities Association.

Associations and Societies

New York Section, I. E. S.—Theater lighting will be the topic of the meeting of this section of the Illuminating Engineering Society on Jan. 11. It will be discussed by lighting engineers who are connected with prominent theaters.

Middle West Division, N. E. L. A.—A conference of the Middle West Geographic Division, N. E. L. A., is called by President Bell to meet at the Muehlebach Hotel, Kansas City, on Wednesday, Jan. 10, at 10 a.m., to consider finances and other matters of interest to the industry.

Coming Meetings of A. I. and S. E. E.—The Philadelphia Section of the Association of Iron and Steel Electrical Engineers meets tonight (Jan. 6), when W. J. De Voe will speak on automatic electric services. The Cleveland Section will hold its annual dance and "get-together" meeting on Jan. 13. The Chicago Section will hear an address on "Radio" by a General Electric Company engineer on Feb. 14.

January Section Meetings of the A.I.E.E.—The following Institute section meetings have been scheduled for January, 1923: Boston, Jan. 9, "The Doble Method of Testing Insulators," Frank C. Doble; Detroit-Ann Arbor, Jan. 12, "Electric Transportation System of a Large City," H. M. Gould; Pittsburgh, Jan. 9, "Alternating-Current Substations for City, Industrial and General Distribution Work," A. H. Kehoe; New York, Jan. 19, "The Modern Physics," Dr. M. I. Pupin; Pittsfield, Jan. 18, "Power Development at Niagara," J. L. Harper; Toronto, Jan. 12, "Industrial Heating"; Jan. 26, "Large Power Distribution and Control," P. E. Hart; Worcester, Jan. 18, "The New England Power System," S. C. Moore.

Electrical Club for Sacramento.—Nearly a hundred representatives of the electrical industry of Sacramento, Cal., met with a large delegation from the San Francisco Electrical Development League last month to discuss the advisability of forming a permanent electrical club in the Sacramento district. The purposes of the club would be social, educational and commercial. A resolution favoring its formation was passed.

Western Association of Electrical Inspectors to Discuss Code Revision.—At the eighteenth annual meeting of the Western Association of Electrical Inspectors, which will be held at the Hotel Sherman, Chicago, Jan. 23, 24 and 25, almost the entire program will be devoted to presentation and discussion of proposed changes in the National Electrical Code. The meeting will thus be one of the most important the association has held. It is planned to have the chairman of each standing committee or the chairman of each technical sub-committee of the electrical committee of the National Fire Prevention Association present the changes in the code related to the work of each committee and explain the reasons for and import of each suggestion.

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published on page 78 of this issue of the ELECTRICAL WORLD.]

Federated American Engineering Societies—Washington, Jan. 11-12.

National Council Lighting Fixture Manufacturers—Cleveland, Jan. 15-20. C. H. Hofrichter, 231 Grodon Square Bldg., Cleveland.

Lighting Fixture Dealers' Society of America—Cleveland, Jan. 15-20. J. L. Wolf, Electrical League, Hotel Statler, Cleveland.

Western Association of Electrical Inspectors—Chicago, Jan. 23-25. W. S. Boyd, 175 W. Jackson Blvd., Chicago.

Iowa Engineering Society—Des Moines, Jan. 23-26.

Wisconsin State Association of Electragists—Milwaukee, Jan. 24-26. H. M. Northrup, 23 Erie St., Milwaukee.

Association Municipal Electrical Utilities of Ontario—Toronto, Jan. 25-26. S. R. A. Clement, 190 University Ave., Toronto.

Electrical Supply Jobbers' Association—Central Division, Chicago, Feb. 13-14; Atlantic Division, New York, Feb. 14; executive committee, Atlantic City, Feb. 15-16. Franklin Overbagh, 411 S. Clinton St., Chicago.

American Institute of Electrical Engineers—New York, Feb. 14-16. F. L. Hutchinson, 33 West 39th St., New York.

American Institute of Mining and Metallurgical Engineers—New York, Feb. 19-21.

American Physical Society—New York, Feb. 24. D. C. Miller, Case School of Applied Science, Cleveland.

Oklahoma Utilities Association—Oklahoma City, March 12-14. O. D. Hall, 1106 First National Bank Bldg., Oklahoma City.

Southwestern Division, N. E. L. A.—Oklahoma City, March 14-16. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Illinois State Electric Association—Chicago, March 16-17. R. V. Prather, 305 Mine Workers' Bldg., Springfield, Ill.

Wisconsin Utilities Association—Milwaukee, March 22-23. John N. Cadby, 445 Washington Bldg., Madison.

American Electrochemical Society—New York, May 3-5.

National Electric Light Association—New York, June 4-8. M. H. Aylesworth, 29 West 39th St., New York.

Recent Court Decisions

Contracts Voided for Want of Mutuality.—In suits brought by the incorporated town of Laurens and other towns in Iowa against the Northern Iowa Gas. & Electric Company the United States Circuit Court held that contracts between the towns and the electric company obligating the company to furnish electricity to the towns without requiring the towns to purchase the electricity, except as they might desire, cannot be specifically enforced, the contracts being void for want of mutuality.

Telephone Workman Maintaining Wires on Electric Light Company's Poles Not Trespasser.—A telephone workman climbed an electric light pole bearing telephone wires on which he had been told to work and was killed by contact with electric light wires insufficiently insulated (Cappuccio vs. Hammonton Electric Light Company). The defendant claimed that the workman was a trespasser, that there was no proof of negligence on its part and that the man was guilty of contributory negligence since he wore no rubber gloves and did wear spurs. The Supreme Court of New Jersey ruled against the defendant on all three contentions, pointing out that the question of gloves and spurs was in this case immaterial since the victim of the accident made contact with the high-tension wire with his knee. (118 At. 712.)*

Contract Rates Binding Until Exercise of State Regulatory Power.—In Sumter Gas & Power Company vs. City of Sumter, the United States Circuit Court of Appeals for the Eastern District of South Carolina found that where a city is empowered to make regulations with respect to streets, but is not empowered to make contracts fixing the rates to be charged by corporations given the right to use streets, the state has a right in the exercise of its police power to change the rates fixed by the contract giving a company the right to use the streets; but where the state does not exercise its right to change such rates, the rates are binding on both parties and cannot be changed by the court. A further finding was to the effect that where a city without the right to so do entered into a contract with a company fixing the maximum rates to be charged by the company the Legislature by ratifying such contract could make it an irrevocable contract with the same force and effect as if the statute authorizing the city to regulate rates had been enacted cotemporaneously with the ordinance granting the company the franchise fixing the rates, since the company, having accepted the agreement and received the benefits, could not complain of its subsequent legislative sanction and ratification. (283 Fed. 931.)

Contributory Negligence as a Question of Law.—Two boys, walking along a path at night, came into contact with a loose wire hanging from a telephone line and swung it in such a way that it came into contact with a trolley transmission line and both boys were killed. The Supreme Court of Pennsylvania, in Sebring vs. Bell Telephone Company and Flesher vs. Same, has declared that the boys were not guilty of contributory negligence as a matter of law, that the proximate cause of the injury was rightly left to the jury to determine, and that the telephone company was guilty of negligence in not inspecting its line, from which testimony showed that the loose wire had hung for weeks. (118 At. 729.)

Rule Requiring Deposits Held to Be Discriminatory.—The Court of Appeals of Kentucky has declared for the plaintiff in Barriger vs. Louisville Gas & Electric Company, finding discriminatory a rule whereby about 10 per cent of the consumers were required to put up deposits or furnish a written guaranty that their bills would be paid, while about 90 per cent were not required to furnish security of any kind, all the consumers being charged the same rates for services rendered. The deposit was ordered returned to the plaintiff with the interest due, but the court refused to allow him to sue for similar relief to about three thousand others, holding that the claims of other consumers were several and could not be joined in one action. (244 So. 690.)

Power of Courts to Reverse Ohio Commission.—Pointing out that on reviewing an order of the Ohio Public Utilities Commission it is not the province of the court to fix a rate or make stipulations concerning the service to be furnished, but only to determine whether the commission's order is unlawful or unjust, the Supreme Court of Ohio reversed the commission in an action brought against it by the city of Cincinnati because of a new schedule of telephone rates authorized by the commission. No authoritative opinion was filed because the judges did not agree on their grounds for the judgment. The chief justice, however, held that the company had failed to sustain the burden of proof and criticised the method of valuation followed. (137 N. E. 36.)

No Recovery for Injury to Boy Courting Danger.—An eight-year-old boy was injured when, in order to get a birds' nest, he climbed to the high part of a railroad bridge and touched a bare electric wire 19 in. from the strut which he had climbed. Damages awarded his guardian were affirmed by the United States Circuit Court (Fruchter vs. New York, New Haven & Hartford Railroad), and the case was appealed to the United States Supreme Court on a writ of certiorari. This court has reversed the judgment and remanded the case, finding an absence of any evidence that the railroad company directly or by implication invited or licensed the boy to climb to the point from which he touched the wire, in opposition to the supposed theory of the trial jury that the structure was both dangerous and attractive to children and that failuse to supply proper guards, human or mechanical, constituted negligence. (43 S. C. R. 38.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Franchise-Tax Exemption Not a Factor in Valuation.—In reducing from the $104,000 requested to $78,100 the amount of 7 per cent preferred stock which the San Diego Consolidated Gas & Electric Company would be permitted to issue to purchase the Coronado system of the United Light, Fuel & Power Company, the California Railroad Commission excluded from the valuation $25,000 said to represent the value of the exclusive franchise rights possessed by the Coronado Company in its territory. No value, the commission maintained, can be placed on a franchise on the theory that an existing utility can operate without payment of a franchise tax while a new utility would have to pay such a tax.

Public Rights in Water Powers.—Seventy-six investigations undertaken by the Public Utilities Commission of Utah into contracts made between the Utah Power & Light Company and large users of power were brought to a close recently when the commission ordered the standard schedules to apply to the Bamberger Electric Railroad with some special allowances. In this case the equity of special rates from the power company to the railway company was predicated upon the value of certain water rights which the railroad company had surrendered, the power company acquiring the benefit inherent in them. The commission refused to entertain a valuation of these water rights based on comparison with the cost of coal. The State of Utah, it pointed out, has splendid natural advantages regarding the development of water rights, and to put "value upon water rights equated to the competitive cost of coal which must later be capitalized and reflected in rates paid by the consumers would operate to deprive the public of these natural advantages and be destructive of public right. To value water rights solely upon this basis would benefit hugely the owners of these water rights who secured them under state and federal laws at nominal expense and would be inimical in the end to the very parties who now propose it. The benefit of available water power should move to both the producer and consumer of water power. This cannot be under any such theory."

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men
Engaged in all Branches of the Electrical Industry

Friends Honor Dr. Weston

Dr. Edward Weston, head of the Weston Electrical Instrument Company, was the guest of honor at a dinner given on Thursday evening, Dec. 28, at the Hotel Commodore, New York City. Prof. Michael I. Pupin of Columbia was toastmaster and the guests presented Mr. Weston with a silver loving cup. Dr. Weston is a charter member of the American Institute of Electrical Engineers and a past-president of the organization.

H. V. Rees, who has been with the Fruit Growers' Express Company for some time, has joined the commercial department of the Ohio Power Company.

F. L. Ball, local manager of the Fitchburg (Mass.) Gas & Electric Light Company, has been elected vice-president of the Fitchburg Chamber of Commerce.

Otto E. Osthoff, vice-president of H. M. Byllesby & Company and of the Standard Gas & Electric Company, has withdrawn from these corporations and their subsidiaries as of Dec. 31.

M. F. Riley of New York, president of the Birmingham Water Works Company, has resigned to become president of the Potomac Public Service Company of Maryland, which is also a subsidiary of the American Water Works & Electric Company.

Yasuhige Hayashi, managing director of the Uji River Electric Company and vice-chairman of the board of directors of the Nippon Electric Company of Osaka, Japan, recently visited California and made a study of high-tension transmission systems. He is especially interested in the transmission of energy at 220,000 volts.

Clarence A. Whitmyer of the General Electric Company succeeded George R. Lunn as Mayor of Schenectady on Jan. 1, when Mr. Lunn became Lieutenant-Governor of New York. Mr. Whitmyer, who is president of the Common Council, has obtained a year's leave of absence from his position with the General Electric Company and will serve the remaining year of Mr. Lunn's term as Mayor.

R. S. Johnson, senior student in electrical engineering, has been appointed to the electrical fellowship maintained by the Wisconsin Utilities Association at the University of Wisconsin on the nomination of Edward Bennett, professor of electrical engineering at the university. The fellowship is maintained to encourage research work on problems whose solution helps to improve the quality of service rendered by public utilities and to bring students more closely in contact with the operating difficulties of the different companies. This year Mr. Johnson will devote his research work to the problems involved in eliminating electric disturbances on telephone circuits.

Major Bennion Receives the Distinguished Service Medal

Major Howard S. Bennion, the assistant chief engineer of the Federal Power Commission, a post he has held since the commission was created, has been presented with a distinguished service medal by the Secretary of War. The medal was awarded to Major Bennion for his accomplishments as chief of camouflage with the American Expeditionary Forces.

H. S. BENNION

Major Bennion has served with the Corps of Engineers since his graduation from West Point in 1912. He was graduated from the Army Engineer School in 1915. After the armistice Major Bennion was placed in charge of road maintenance throughout a large portion of the devastated area in France. With the completion of that service he was made a member of the United States Liquidation Commission in Paris and later was made executive officer of the Chief Engineer of the American Expeditionary Forces.

Capt. Clarence S. Jarvis of the United States Army Engineering Corps was the speaker at the weekly luncheon of the Provo (Utah) Rotary Club Dec. 8. He spoke on the engineering features of the Colorado River project and outlined engineering problems involved in the building of the dam.

E. C. Headrick Chosen to Advisory Board of Electrical Body

E. C. Headrick, an electrical contractor of South Denver, Col., and a member of the advisory board of the Electrical Co-operative League, has been elected to serve on the executive committee of the Association of Electrical Contractors and Dealers. Mr. Headrick, who is the first Denver man to be named on this board in many years, will represent the Mountain Division of the Association of Electragists International, comprising Colorado, Wyoming, Utah, New Mexico, Arizona, Montana and a part of Idaho. He succeeds E. H. Hardley of Salt Lake City. For several years Mr. Headrick was president of the local association of electrical contractors and dealers, and he is a past-chairman and one of the organizers of the Electrical Co-operative League.

Warren R. Voorhis, who has been associated with the American Water Works & Electric Company, Inc., New York City, for several years, was recently elected a vice-president of the company by the board of directors.

S. A. Wills, formerly power engineer for the Atlantic City Electric Company, has been transferred to the Ohio Power Company's Canton office. Both these companies are properties of the American Gas & Electric Company.

Paul Wilson, who for seven years has managed the office of the San Joaquin Light & Power Company at Madera, Cal., has been promoted to the position of district manager at the Fresno office. Mr. Wilson took up his duties there on Jan. 1.

James A. Bennett, Meriden, Conn., has been appointed sales manager of the Connecticut Telephone & Electric Company, Meriden, Conn., manufacturer of electrical and telephone goods. Mr. Bennett succeeds Charles E. Stahl, resigned.

John W. Carpenter, vice-president and general manager of the Texas Power & Light Company, has just completed a trip of several weeks through the cotton-mill regions of the United States. He made the trip to complete a survey of the textile situation with the view of assembling complete data for use of communities on the lines of his company's transmission system and for others in Texas who may desire the information.

H. W. Watt, engineer of electric distribution of the Westchester Lighting Company, has returned from a meeting in Albany of the managing committee of the Electric Section of the Empire State Gas and Electric Association. Mr. Watt said that the committee plans to map out a program of study of new processes and developments in the electric central-station field with a view to the general adoption by companies in New York State of any feature found to possess possibilities of economy or operating efficiency.

Changes at Schenectady

Vice-president G. E. Emmons of the General Electric Company recently announced a reorganization of the general manufacturing department of the company effective on Jan. 1. It includes the appointment of H. F. T. Erben, heretofore manager of the Schenectady works, as vice-chairman of the manufacturing committee and ranking member of the general manufacturing staff.

The vacancy thus created in the position of manager of the Schenectady plant has been filled by the advancement of Charles E. Eveleth, who had served since Sept. 1 as assistant works manager under Mr. Erben. Mr. Eveleth becomes works manager. J. A. Smith will continue as general superintendent and in the absence of Mr. Eveleth will be in charge of the works.

The general manufacturing department, of which Vice-president Emmons is in charge, will be as follows: H. F. T. Erben, vice-chairman of manufacturing committee and ranking member of the staff; J. T. Broderick, secretary of the manufacturing committee; L. G. Banker, general purchasing agent; M. C. Fitzgerald, manager of transportation department; W. C. Fish, manufacturing engineer; W. B. Curtiss, supervisor of production; G. S. Maxwell, supervisor of costs; E. Z. Steezer, supervisor of industrial relations.

James J. Withrow is now manager of the Sheridan County Electric Company, Sheridan, Wyo., replacing Judson Bibb.

W. B. McGorum has been transferred from the statistics department of the Stone & Webster organization to the Key West (Fla.) Electric Company.

N. S. Patterson, formerly superintendent of the meter department of the Natrona Power Company, Casper, Wyo., is now resident manager of the Big Horn Utilities Company.

John S. Ferguson, formerly associated with the Massachusetts Institute of Technology, has joined the statistics department of the Stone & Webster organization.

H. V. Schreiber, associated with the Charles B. Hawley Construction Company of Washington, D. C., is at present in New Zealand, where he will spend five or six months.

E. A. Hanff, formerly electrical engineer with the Pittsburgh Electric Furnace Corporation, has become associated with William Swindell & Brothers, Pittsburgh, in the electric furnace department.

William E. Horner is now superintendent of the Heber (Utah) City Light & Power Company, succeeding E. Parley Cliff, who died last May. Mr. Horner has been associated with the company for more than ten years.

Alexander Macomber of the engineering firm of Macomber & West, Boston, has been elected treasurer of the Charlestown (Mass.) Gas & Electric Company, succeeding Samuel J. Fowler, who is retiring from active connection with the company, though continuing as a director. Mr. Macomber, who is well known in utility circles throughout New England, will continue his active connection with his engineering firm.

Roy E. Heffner, until recently instructor in the department of electrical engineering, Cornell University, has become affiliated with the John B. Stetson University, Deland, Fla., where he will teach in the newly organized engineering college.

C. O. Mailloux, president of the International Electrotechnical Commission, returned to this country recently. Mr. Mailloux sailed for Europe early in November to attend the meeting of the commission held in Geneva.

G. I. Dorr has resigned his position with the Star Electric Motor Company and will be affiliated with the sales department of the Continental Electric Company, Inc., manufacturer of electric power apparatus. Mr. Dorr will make his headquarters at the main office of the company at Newark, N. J.

C. M. Stevenson, who was district sales manager at Toledo, Ohio, for the Colonial Steel Company until the branch was discontinued, has severed his connection with the organization, having been elected a director and appointed general manager of the Reinforced Switch & Manufacturing Company, Pittsburgh, manufacturer of a patented reinforced switch and fuse clip.

L. W. Staunton New Brandes Advertising Manager

L. W. Staunton, former research manager of the Herold-Garber Company, Indianapolis, has been appointed advertising manager of C. Brandes, Inc. Previously Mr. Staunton was in charge of the merchandising section, department of publicity, Westinghouse Electric & Manufacturing Company, in which capacity he had considerable responsibility in the production of radio publications. Most of Mr. Staunton's business experience has been along advertising and sales lines. Previous to his connection with the Westinghouse company he was affiliated with the publicity department of the Taylor Instrument Company of Rochester, N. Y.

A. S. M. E. Gives Prizes

Prof. Robert C. Heck of Rutgers College has been awarded life membership in the American Society of Mechanical Engineers for a paper on "Steam Formulas." R. H. Heilman, industrial fellow at the Mellon Institute, Pittsburgh, and F. L. Kallam, graduate student at Leland Stanford, Jr., University, were awarded junior prizes of the society. Mr. Heilman's paper dealt with "Heat Losses from Bare and Covered Wrought-Iron Pipe at Temperatures Up to 800 Deg. F." Mr. Kallam won the honor for a "Preliminary Report on the Investigation of the Terminal Conductivity of Liquids."

Dr. Franklin Heads American Chemical Society

Dr. Edward C. Franklin, professor of organic chemistry at Leland Stanford, Jr., University, has been elected president of the American Chemical Society, succeeding Dr. Edgar F. Smith of the University of Pennsylvania.

Dr. Franklin was a member of the advisory board of the United States Bureau of Mines in 1917-1918 and physical chemist of the United States Bureau of Standards and consulting chemist of the Ordnance Bureau of the army during the war. His work on liquid ammonia as an electrolytic solvent is familiar to all chemists. Dr. Franklin was born at Geary City, Kan., and is a graduate of the University of Kansas.

Obituary

Solomon Lewenberg, formerly a member of the Massachusetts Gas and Electric Light Commission, died at Boston on Dec. 24. Mr. Lewenberg, who was born in Boston in 1876, was a lawyer by profession. He served on the commission from 1916 to 1919.

Frank Kivel, publicity manager for the Denver Gas & Electric Light Company, died recently at the age of forty-two. Mr. Kivel, who was a native of New Hampshire, went to Denver about fifteen years ago. He was a member of the publicity committee of the National Electric Light Association. Interment was at Dover, N. H.

James P. Dusenberry, aged seventy-eight, a director of the Public Service Corporation of New Jersey and formerly its treasurer, died of heart disease on Dec. 24 at his home in Newark, N. J. He was treasurer of the old Newark Gas Light Company, and when it was absorbed by the Public Service Corporation he became treasurer of the latter. He retired from that post eight years ago.

Charles Perry Lindsley, vice-president of the Lindsley Brothers Company of Spokane, Wash., died at Hot Lake, Ore., Dec. 27, at the age of fifty-five years after an illness of several months. Mr. Lindsley was president of the Lindsley Brothers Canadian Company, Ltd., at Nelson, B. C., and vice-president of the Barnes-Lindsley Manufacturing Company, manufacturer of Douglas-fir cross-arms at Portland, Ore. He was one of the promoters of the Cœur d'Alène Electric Railway Company and the Pend d'Oreille River Navigation Company and a pioneer in the lumber and cedar-pole industries. He was born in Neenah, Wis., going to Spokane in 1901, where he, with his brothers, E. A. and G. L. Lindsley, organized the Lindsley Brothers Company, which is one of the largest producers of Western red-cedar poles in the United States and Canada.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Review of the 1922 Electrical Market

Total Production Estimated at $920,000,000 — Wholesome and Steady Growth a Feature—Economic Trend Steadily Progressive—Slight Setbacks Were of Constructive Character

By H. M. Cunnington
Trade and Markets Editor Electrical World

A WHOLESOME and steady growth marked the manufacturing division of the electrical industry in the year just ended. Total production of the year is conservatively estimated at $920,000,000. This figure compares with $625,000,000 in 1921, a year of depression, and with $1,250,000,000 in 1920, the peak of the boom period.

According to reports from a large number of manufacturers, the production of electrical and allied mechanical equipment has been almost phenomenal. Orders have come chiefly from central-station companies, as distinguished from other users of electrical equipment, although the industrial-plant users of electrical equipment were at one time large buyers. The unprecedented demand from central-station companies during 1922 is attributed by many manufacturers to the fact that public utilities were unable during the war to make necessary extensions, repairs and improvements, owing to the unavailability of equipment and scarcity of money at reasonable prices. As a result, utilities have not expanded at a normal rate during the last four or five years, but now they are in an enviable financial condition and money is available at more reasonable rates, which enables them to make up for past inactivity and buy in heavier volume. Some manufacturers also report a large demand for electrical and allied equipment which is directly or indirectly the result of increased building.

A notable expansion in the use of industrial heating devices, furnaces, ovens, etc., is noted. As compared with 1921, the volume of applications of this nature for the year just ended showed an increase of more than 50 per cent in kilowatt capacity. This particular method of applying electricity for industrial heating has now been on a practical commercial basis for about six years, during which time the heating units installed have aggregated about 500,000 kw. in capacity.

New Construction Helped All Lines

The greatest factor entering into the increased consumption of electrical apparatus and supplies has been the record-breaking volume of construction started and completed during the year. Conduit stocks have been abnormally low all through the latter nine months as a principal result, wire mills have rushed to keep up with orders, and manufacturers of all relative supplies have progressed accordingly. As was to be expected, with the general growth of demand, a gradual stiffening of prices of conduit, armored cable and wire occurred in the market during the year.

In general, the economic trend of the electrical industry was almost steadily progressive. Even when slight setbacks occurred, they were of constructive character. Prolonged strikes in the railroad and coal industries only temporarily checked progress of manufacturers in gathering together their raw materials for production and timely shipments. Although manufacturers encountered other obstacles, substantial recovery in the industry would not have come if previous far-reaching readjustments had not eliminated many of the weak spots and placed business on a more stable basis.

Lamps. — All through the year there has been an increased demand for blue sign lamps. The demand for better street lighting, lamps and equipment has shown a marked increase, due to the recognition of the fact that good street lighting is effective in increasing the speed safety of traffic and in reducing crime. A large number of cities which have held back in semi-darkness for a period of years are now taking advantage of lower costs to make much-needed improvements. In view of the extensive building program, much attention has been given the subject of school lighting. In the past year several large cities gave careful consideration to this subject—for the first time. There has been a notable increase of interest in equipment suitable for the lighting of all classes of outdoor sports, fostered, no doubt, by lower installation cost.

Conduit Stocks Low During the Year

Conduit. — All during the year the lowest stock in the wiring line was rigid conduit. Raw-material shortage was the principal reason for this condition. When shipments from the mills did commence to improve, heavier demands from the building industry caused greater concern. Prices were strong throughout the year.

Motors. — Business in motors showed constant improvement all through the year Although small-order sales dominated the market, their persistence and tendency to multiply offered much encouragement to the manufacturer and jobber of first-class products. During the past year sales of motors were subject to extremely acute competition and were accompanied by more "proposition" work and technical analysis than has been the case for a long time. On this account certain new designs of motors have made better headway in the market than might have been expected, and the competition between makers of advanced designs and some of the older builders of motors was exceptionally sharp for the amount of business offered.

Control Devices. — During the earlier months of the year competition was very keen among manu-

facturers of control devices. In comparison with the business of later months very little business was in the market. Between January and May prices were reduced materially and some attractive orders were secured merely on price bases, and special prices were made in special cases. During the latter half of the year business picked up and there was some strengthening of prices.

Switchboards and Panelboards.— Although business in switchboards and panelboards was sluggish during the first five months, a continued increase became apparent in the middle of the year and improvement continued throughout the remaining months. Conditions in the northern part of the country were slightly better than in the southern sections. Construction, as in other lines, caused the curve of sales to mount rapidly in the last half of the year.

Residential Meters. — Consumption of watt-hour meters (house type) is conservatively estimated at 1,750,000 for the year 1922. Manufacturers have reported that production of this article is well over the 1,900,000 mark. The associated activity of meter protective and safety equipment also had a remarkable development.

Hollow Ware. — Excellent business in appliances for table service was enjoyed throughout most of the year. A leading manufacturer of these devices states that during the last few weeks stocks were greatly reduced and in some cases jobbers' stocks were cleaned out by the unordinary heavy purchasing during the Christmas season. Heavier appliances were active throughout the year, which was contrary to jobbers' expectations. Toasters, irons, grills and percolators were particularly strong throughout the year, and during December some manufacturing by night shift was reported. Very little complaint is heard from the consumers in the matter of prices and interest seems to be increasing each month. Raw materials were not plentiful throughout the year because of poor railroad transportation. However, there is improvement in that quarter and easier and more profitable days are promised for the manufacturers.

Dry Batteries. — Although production of dry batteries was almost 20 per cent lower than the 50,000,000 manufactured in 1921, the market during the past year was one of strength, considering the ever-increasing popularity of bell-ringing transformers and other apparatus which are rapidly taking the battery's place in the market. During the year large numbers of batteries were sold to the radio enthusiasts. Railroads and the automotive fields were also large purchasers.

Storage Batteries Gained Materially

Storage Batteries. — A gain of 25,000,000 in production of storage batteries was shown in 1922, due to the increased activity in the radio line and in automobiles.

Trucks.—Business men today are looking into the question of delivery costs as never before and are finding that too great a percentage of their gross receipts is being spent for delivery charges. With accurate costs from their own haulage and delivery records, they have found that electric trucks are very much more economical for haulage and delivery on city routes than either gasoline trucks or horses. The sales of electric trucks during the twelve months just ended indicate a steadily increasing demand. Production in 1921 was 1,000, compared with 1,250 in 1922. The year 1922 found a much greater demand for electric trucks for city deliveries, and the outlook for 1923 is excellent. There are now nine manufacturers of electric street trucks, with every probability that some of the gasoline-truck manufacturers wil be included by the end of 1923.

Better Selling Helped Vacuum Cleaners

Vacuum Cleaners. — By better training of salesmen and improving selling methods manufacturers and jobbers of vacuum cleaners have developed a greater potential market than they had in the years 1920 and 1921. There was very little "order taking" during the year; instead, it was twelve months of stiff competition and directed sales efforts. It is said that 700,000 vacuum cleaners, valued at $35,000,000, were manufactured during the year just ended. This is an increase of 100,000 cleaners over 1921, but a large decrease of 325,000 cleaners from the year 1920. Better general business conditions, of course, caused this improvement in the market. Shipments generally were prompt all during the year, averaging from one to ten days. Very few price reductions were made during 1922, although a few manufacturers during the days of heavier competition included attachment sets free in order to gain better attention.

Farm-Lighting Plants. — Large crops for the farmers have permitted the expenditure of more money for general improvements in the rural districts. According to one of the largest manufacturers of these sets, sales have been very large. The outlook for the future winter months is very encouraging. Deliveries have been affected somewhat by the recent railroad tie-up, but the year ended showed decided improvement. Exports have been unusually good.

Wiring Devices. — Gradual improvement in the demand for wiring devices is noted. The expansion of the building industry was a helpful factor in the situation. Plants throughout the country ran full

Interesting Financial Comparisons

Electrical Manufactured Products,	1922	$920,000,000			
	1921	625,000,000			
	1920	1,250,000,000			
Farm crops (value),	1922	$7,572,890,000	Pig iron output (tons),	1922	†23,793,000
	1921	$5,729,912,000		1921	†14,894,000
Merchandise exported, eleven months,	1922	$3,491,633,000	Unfilled steel tonnage,	1922	6,840,000
	1921	$4,188,832,000		1921	4,250,000
Commercial failures,	1922	$615,257,000	Cotton consignments, bales,	1922	†5,561,000
	1921	$627,401,000		1921	†4,896,000
Bond sales (par value),	1922	$4,130,900,000	Dun's index number,	1922	$185,462
	1921	$3,402,538,000		1921	$164,531
Stock sales (shares),	1922	262,500,000	‡ Federal Reserve ratios,	1922	80.4 per cent
	1921	173,127,000		1921	73.1 per cent

† Eleven months. ‡ Highest ratios.

time through the year. Raw material was plentiful and buying was well distributed. Foreign trade went to very low levels, the exchange situation barring much expansion in that field.

Poles. — During the months of March, April and May producers of poles showed their confidence in that market by raising their prices twice. The first time was the middle of March, when the increase was confined to a few sizes. Prices previous to March had been descending for more than a year. This current increase, it was pointed out, was a definite sign that the market was again on the up grade and that the producers, as opposed to the small brokers or selling agencies, were once more in control of the situation. Demand in all sections of the country remained good, with some sections, such as the Southwest, particularly active. Stocks generally were good, although not too heavy, and producers found little trouble in making shipments until the recent rail difficulties.

Porcelain. — A noticeable improvement in the low-tension or dry-process electrical porcelain business was evident all through the year. This improvement was particularly noticeable in the demand and distribution of standard items as sold by the jobbing trade. These products entered directly into the construction of the many new building erected.

Production of Electrical Equipment and Supplies During 1920, 1921 and 1922

Item	1920 (Revised)		1921		1922	
	Number of Units	Value	Number of Units	Value	Number of Units	Value
Insulated Copper Wire:						
Rubber covered		$85,000,000		$40,000,000		$60,000,000
Total code	1,700,000,000 ft.	30,000,000	1,271,000,000 ft.	17,408,000	1,700,000,000 ft.	25,000,000
No. 14 code	1,105,000,000 ft.	11,250,000	890,000,000 ft.	5,785,000	1,200,000,000 ft.	7,000,000
Flexible cords	204,000,000 ft.		95,000,000 ft.		133,000,000 ft.	1,500,000
Generators:						
Waterwheel			196,000 kw.	1,100,000	200,000 kw.	
Turbo			510,000 kw.		575,000 kw.	
Motors:						
Fractional		40,000,000		15,000,000		30,000,000
1 hp. to 50 hp.		66,000,000		30,000,000		50,000,000
51 hp. to 200 hp.		11,000,000		5,000,000		7,500,000
Above 200 hp.		4,000,000		1,000,000		1,600,000
Transformers:						
5-kva. and under	330,000					
Above 5 kva.	660,000					
Distribution type		11,400,000		6,000,000		12,000,000
Power type		13,200,000	1,950,000	6,000,000		11,000,000
Meters, Watt-hr. (house)	2,200,000		1,500,000*		1,750,000*	
Control, industrial		25,000,000		15,000,000		25,000,000
Lamps:						
Type "B"	172,000,000		134,000,000		165,000,000	
Type "C"	43,000,000		27,000,000		40,000,000	
Carbon	15,000,000		7,000,000		5,000,000	
Miniature	105,000,000		105,000,000		95,000,000	
Socket Devices:						
Heating appliances:						
Domestic		23,400,000		14,040,000		17,000,000
Industrial		1,500,000		900,000		1,100,000
Fans	950,000	13,900,000	700,000	10,000,000	900,000	10,500,000
Washing machines	600,000	72,000,000				
Vacuum cleaners	1,025,000	51,000,000	600,000	30,000,000	700,000	35,000,000
Wiring Supplies:						
Rigid conduit	140,000 tons	20,300,000	58,000 tons	7,000,000	80,000 tons	10,000,000
Non-metallic flex. conduit	100,000,000 ft.	4,700,000	98,000,000 ft.	2,500,000	175,000,000 ft.	2,500,000
Metallic flexible conduit	2,300,000 ft.	150,000		100,000		150,000
Flexible armored conductor	71,000,000 ft.	6,400,000		4,000,000		5,000,000
Outlet boxes and fittings		1,800,000		1,200,000		2,000,000
Tape: Friction	18,000,000 lb.		10,800,000 lb.		15,000,000 lb.	
Rubber	2,000,000 lb.		1,200,000 lb.		3,000,000 lb.	
Fuses: Renewable		3,500,000		2,000,000		2,500,000
Non-renewable		3,500,000		2,500,000		3,000,000
Schedule Material:						
Key sockets	13,500,000		7,500,000		14,500,000	
Pull sockets	9,000,000		5,000,000		9,500,000	
Keyless sockets	5,500,000		2,750,000			
Flush switches	9,000,000		6,000,000		7,500,000	
Exposed switches	8,000,000		4,000,000		4,500,000	
Plugs	15,000,000		8,000,000		10,000,000	
Receptacles	15,000,000		8,000,000		10,000,000	
Storage Batteries		125,000,000		83,000,000		125,000,000
Starting and lighting	3,500,000	52,500,000	3,200,000	40,000,000		65,000,000
Dry Batteries	65,000,000		50,000,000		45,000,000	
Electric Vehicles:						
Trucks	5,000	22,000,000	1,000		1,250	

* Consumption

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

Hydraulic Turbine Business Has Favorable Outlook

Although underlying factors are somewhat different from what they were last year, there is no reason why this year's hydraulic-turbine business should not be at least as favorable as it was last year. This is the opinion of Arnold Pfau, hydraulic department, Allis-Chalmers Manufacturing Company, Milwaukee. He says that one factor which seems to deserve even more serious consideration than it probably did last year is the uncertain political situation in Europe, which is bound to affect our country. He says:

"If our foreign markets remain closed or poor to say the least, our industries will naturally work at small load factor so that the power now available will be sufficient. If the price of coal is not materially reduced, there should naturally be a strong tendency to utilize water, which would necessarily favor new developments and possibly reconstruction of present equipment."

Says Electric Washer Sales Gained 44 per Cent

A year ago the American Washing Machine Manufacturers' Association issued a statement through the ELECTRICAL WORLD to the effect that the year 1922 would show steady and substantial gains in washing-machine sales. According to E. B. Seitz, secretary of that organization, that prediction has been fulfilled. For the first eleven months of last year the gain for all washers has been approximately 37 per cent over the corresponding period of 1921; the gain for electric washers has been about 44 per cent. Every month has shown an improvement over the preceding month with the exception of July, the strike month, and November, beginning the pre-inventory decline. The volume in dollars for the year should show nearly a 50 per cent increase for the electric machines, indicating that somewhat stronger prices have prevailed.

Washing-machine manufacturers confidently expect this improvement to continue throughout the year 1923. They are buying against increased production and in many cases enlarging manufacturing capacity to provide for a thriving year's business. Among the pertinent reasons given for this optimism are: First—There were more than 1,200,000 homes wired in 1922, and a very high percentage of these were wired for the sole purpose of enabling the housewife to have the use of electrical appliances. Second — Sales are easier on a rising market. Third—"Orphaned" washing machines of bankrupt companies have disappeared from the market. Fourth—A more thorough appreciation of the other man's problem prevails as between manufacturers and dealers. Fifth—The great electrical program for America will undoubtedly reach its widest stage of development in 1923.

Recent Tariff Decisions

Union of South Africa.—It has been decided that wireless-telegraph apparatus, including broadcasting sets, is subject to an import duty of 20 per cent ad valorem under the Union of South Africa tariff. British goods are entitled to a rebate of 3 per cent.

Australia.—According to recent decisions, the following import duties are leviable under the Australian Commonwealth customs tariff: Accumulators for stationary use and plates for use therewith, 10 per cent ad valorem under the general and 5 per cent under the intermediate tariff, British goods free; electrical equipment, consisting of motors, controllers, switches and auxiliary apparatus, for the operating of "bogy" and other tramcars, 10 per cent under general and free under intermediate and British preferential tariffs; electric regulator equipment for controlling two 100-kw. alternators and 600-kva. rotary converters, including transformers and switchgear, 10 per cent, 5 per cent, free; 600-kva. synchronous condensers, 10 per cent, free; 600-kva. synchronous converters and mixed-pressure turbines (ordered prior to March 1, 1922), 10 per cent, 5 per cent, free.

Brazil Offers Opportunities

The market for electrical goods in Brazil promises to develop considerably in the next few years. The position of the United States is very good and American firms are well represented in the field. At the present time American products are in good demand, with Germany felt as the nearest competitor.

Possibilities in Nanking

Market possibilities for electrical goods in the Nanking district of China are by no means limited, when it is considered that this area contains 50,000,000 to 60,000,000 inhabitants, with numerous large cities and towns as yet without electric light plants. In fact, the electric light only made its advent there in the last decade and the rapid extension of the use of electricity has been remarkable.

Chinese buyers show a decided unwillingness to purchase by correspondence, and the use of catalogs and literature alone are equally ineffective. The greatest success has been achieved by firms that either maintain their own representatives in Shanghai or have given agencies to American firms in that center which are equipped to handle electrical materials and supplies to advantage. It is considered best to give agencies only to firms having Americans in their employ. Otherwise they very often do not push the American product.

The Metal Market

Consumption in All Metals Continues Excellent—Higher Copper Prices—Lead Remains Inactive

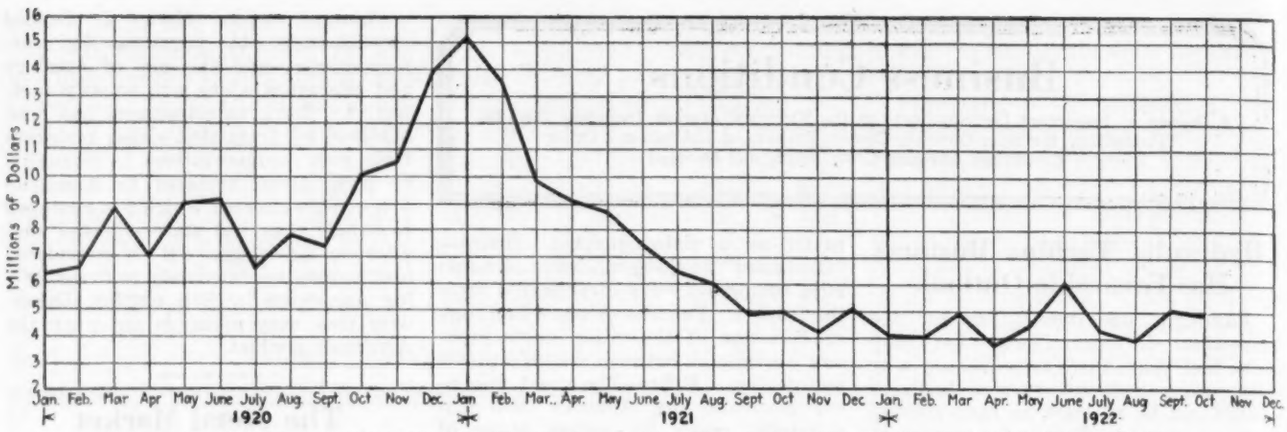
All of the producers who were selling copper at 14.50 cents a week ago seem now to have raised their price to 14.75 cents, delivered, although it might be possible for large consumers with plants in and about New York City still to obtain copper for early delivery at the lower price. There is some tendency among producers who are well sold up to quote 14.87½ cents, but this price so far has been largely a nominal one, although it would be difficult to obtain copper for April or later delivery at much under that figure. Fundamental conditions are so good that producers are decidedly optimistic. Consumption in all metals continues excellent.

The lead market has been decidedly inactive, and few important orders have been placed, and these mostly at average prices. Plenty of lead seems to be available at 7.25 cents, New York, even for prompt delivery. In the Middle West supplies of spot metal are not so large, but most consumers are satisfied with January shipment. St. Louis prices are showing a slight tendency to advance. Desilverized is commanding about 5 points premium at some consuming centers in the Middle West.

The slightly weaker zinc market is attributed by some producers to a stagnant domestic market and by others to a poor demand from abroad compared with a few weeks ago. Probably both are correct. At any rate, it has not been difficult to obtain metal for both prompt and forward delivery in ordinary tonnages. Although some business has been quoted at 7 cents, it has practically all been confined to carload lots. The premium for prompt shipment has disappeared. High grade is selling at 7.75 to 8.25 cents.

NEW YORK METAL MARKET PRICES

	Dec. 27, 1922 Cents per Pound	Jan. 3, 1923 Cents per Pound
Copper		
Electrolytic	14.50	14.75–14.87½
Lead, Am. S. & R. price	7.25	7.25
Antimony	6.40	6.35
Nickel, ingot	36.00	36.00
Zinc, spot	7.05	7.05
Tin, Straits	38.00	38.87½
Aluminum, 98 to 99 per cent.	23.00	23.00



TOTAL OF ELECTRICAL APPARATUS EXPORTS FROM THE UNITED STATES DURING THE YEARS 1920, 1921 AND 1922

Electrical Apparatus Exports in 1922

Although the total of electrical apparatus exports during the year just ended are far below the peak of the boom years, 1919 and 1920, a healthy condition persists in spite of the difficulties in the foreign markets.

The highest amount of the year, a figure of over $6,000,000, was lower than the lowest amount in all of the year of 1920 and the first six months of 1921. The lowest amount of exports was in April, when they fell below the $4,000,000 mark.

The figures for the first ten months of 1922 are very low in every instance when compared to the months of the two previous years; in no instance will any of these approach previous years' figures.

The greatest recorded drop in exports was for motors, falling from over fifteen million dollars in 1921 to $2,534,137 for the first ten months of 1922. In 1920, motor exports were $13,263,657, and in 1919 they were $10,635,476.

Fan exports held up fairly well throughout the year. They are expected to end the twelve months of 1922 with a total near to $800,000, which figure compares with $1,270,153 in 1921, with $1,365,766 in 1920 and with $1,421,160 in 1919.

Copper wire and cable exports are almost 70 per cent lower than they were in 1921, and it is said that the amounts for the months of November and December will not help these exports in any material way. Last year the total for ten months amounted to $2,895,193, compared to $9,029,525 in 1921, $8,178,539 in 1920 and $8,815,212 in 1919.

Dry batteries exports were other heavy losers during the year. The total for the whole year 1922 is expected to reach close to $1,000,000. This amount compares with $3,821,645 in 1921, $6,633,542 in 1920 and with $5,998,223 in 1919.

Total exports of rheostats and controllers for the twelve months of 1922 are expected to reach or to exceed $800,000.

EXPORTS OF DRY BATTERIES, MOTORS, RHEOSTATS AND CONTROLLERS, FANS, LAMPS, COPPER WIRE AND CABLE, DOMESTIC HEATING AND COOKING APPARATUS DURING 1919, 1920, 1921 AND THE FIRST TEN MONTHS OF 1922

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Dry Batteries													
1922	71,306	72,770	110,108	85,795	106,118	109,494	70,440	79,787	88,441	79,714			873,973
1921	655,712	451,756	412,019	430,235	430,432	246,844	183,525	175,878	271,232	211,758	175,674	176,580	3,821,645
1920	374,730	526,972	690,866	487,472	676,624	578,146	497,657	444,859	607,936	483,109	615,402	649,769	6,633,542
1919	345,811	420,437	579,708	547,430	516,001	787,748	379,021	587,951	442,588	507,704	406,722	477,102	5,998,223
Motors													
1922	186,350	223,875	245,584	295,152	244,245	254,112	327,063	200,614	292,539	264,603			2,534,137
1921	2,064,424	2,426,433	1,571,601	1,711,620	1,641,827	1,437,812	1,121,583	959,773	537,558	525,142	495,966	950,285	15,444,024
1920	733,822	825,727	1,247,85	923,096	1,132,811	1,250,638	709,086	845,729	1,230,408	1,255,539	1,406,149	1,702,846	13,263,657
1919	680,882	1,107,268	838,448	829,113	817,118	1,562,521	546,794	729,608	733,891	1,007,930	1,003,864	778,039	10,635,476
Rheostats and Controllers													
1922	73,535	63,697	52,216	43,170	67,239	86,103	39,346	89,626	106,414	62,246			683,592
1921	161,253	114,235	87,649	164,745	101,663	85,568	61,755	64,456	45,304	77,735	46,381	33,649	1,044,393
1920	18,558	86,482	72,896	66,389	43,365	83,504	26,283	730,818	33,309	64,251	100,295	81,569	1,407,719
1919	48,436	16,442	38,565	30,798	64,478	65,384	26,854	45,833	38,326	63,153	40,655	35,836	514,760
Fans													
1922	47,061	77,229	112,302	96,953	70,794	93,742	51,463	36,036	59,537	45,575			690,332
1921	358,444	309,373	179,939	120,361	77,480	45,540	37,566	32,233	21,129	15,444	43,479	29,165	1,270,153
1920	29,587	79,780	115,069	149,728	152,100	191,434	87,892	54,911	70,489	55,212	122,132	257,432	1,365,766
1919	176,526	121,003	269,934	96,433	201,125	130,817	142,103	53,099	49,768	79,406	68,298	32,648	1,421,160
Lamps													
1922	117,937	143,692	181,991	95,406	127,438	92,120	103,422	94,028	126,705	164,895			1,247,634
1921	630,939	613,955	319,490	408,753	369,411	258,602	164,491	94,981	79,090	110,119	88,099	149,545	3,287,475
1920	218,920	373,309	448,422	364,882	344,226	377,125	251,317	217,113	249,502	372,955	488,036	486,002	4,191,809
1919	598,415	422,739	440,475	468,140	480,351	535,434	245,630	363,792	369,631	343,149	297,368	329,074	4,894,198
Copper Wire and Cable													
1922	290,996	229,848	327,663	308,340	286,738	310,295	275,370	217,264	349,037	299,621			2,895,168
1921	2,903,359	1,123,873	721,647	807,218	860,491	588,211	496,928	305,829	270,145	177,536	411,389	362,899	9,029,525
1920	661,842	567,036	543,546	526,556	791,303	593,370	558,791	420,208	635,641	575,041	1,003,898	1,301,307	8,178,539
1919	804,481	710,830	1,025,867	789,991	838,188	1,420,699	659,893	741,443	301,315	487,444	535,746	499,315	8,815,212
Domestic Heating and Cooking Apparatus													
1922	22,951	30,511	48,123	59,947	47,554	36,186	36,116	30,164	56,748	76,789			445,089
1921	291,546	381,742	180,693	165,962	101,745	77,866	54,262	69,660	95,699	74,302	70,155	73,818	1,637,450
1920	113,819	140,020	135,450	140,715	227,227	164,344	124,485	118,817	95,986	182,715	151,001	206,548	1,801,127
1919	98,515	71,136	151,693	153,342	146,765	192,551	156,745	124,668	91,881	164,114	117,772	110,575	1,579,757

The Week in Trade

Prices When Quoted Are Those Reported at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

THE year 1923 opens with very low appliance stocks in all sections of the country. Construction programs for the coming winter and spring months are most favorable to the whole industry. Some lengthening in motor deliveries for the East is reported. The recent advance in copper is now reflected in the wire market. Prices for sockets and pole-line hardware are firmer. Fixtures and lamps generally are more active than two weeks ago. The outlook for 1923 business is full of optimism.

Year Starts with Action

New York.—The first week of the new year started with more action and lower stocks than did the first week in January, 1922. Wiring-device prices show added strength, motors are in great demand and stocks are low. Fixtures are active with firm prices. Increasing activity in wire is shown. Armored cable has changed from a steady to active demand, and the supply is higher than a few weeks ago. Demand for poles has fallen from active to slow. Pole-line hardware is also slow, as well as the demand for porcelain. Supply of fuses is somewhat better than a week ago. Lamp stocks are higher. Demand for heating appliances has changed from active to slow. Calls for radio sets and parts are fewer following the heavy holiday buying. Betterment in the washing-machine and vacuum-cleaner markets is reported.

Chicago.—With most of the electrical jobbers studying inventories, last week passed rather quietly. Jobbers are all pleased with the Christmas trade since they say it was better than last year's by 10 to 20 per cent. Changes in both price and demand have been few. High-tension manufacturers report another active week. One company sold two 66,000-volt, 9,200-kva. outdoor substations to a utility in the Southwest and two 33,000-volt substations for the Middle West with capacities of 600 kva. and 900 kva.

Boston.—New England's new trade year opened with greatly depleted appliance stocks, lengthening deliveries on motors, scarcity of rigid conduit and an upward trend in prices. The recent advance in copper price has been reflected in wire, and quotations in sockets and pole-line hardware are firmer. The demand for lamps continues very active, and in some quarters deliveries tend to lengthen. Fixture sales are exceedingly active and building operations continue at favorable rate. Deliveries are giving trouble on products from the Middle West and steel-making districts, and railroad embargoes are impeding the flow of washing machines and other products into this section. Optimism is widely felt regarding the outlook for the 1923 business.

Atlanta.—The holiday trade just past has been probably the greatest in the history of this section, all jobbers reporting a very successful season, with a small carry-over and good collections. The regular industrial trade, of course, has shown the inactivity generally expected during this time of the year, due to stock taking and closing of books for the calendar year. A very prompt revival, however, is expected, as it is necessary to replenish stocks for the expected demand for 1923. The building trade continues active. A great deal of residential building is going on, particularly in Atlanta. A large number of the industrial organizations are adding to and improving their present equipment, and in addition to this a number of industries are seeking and finding satisfactory locations in this section of the country. The Atlanta bank clearings for the year just closed will exceed those of 1921 by a hundred million dollars, and as the majority of this gain was experienced during the latter part of the year, the bankers and industrial leaders are extremely optimistic over the prospects for 1923.

Cleveland.—There is every indication that good business will continue as orders on hand assure production until well into the spring. Stocks are low and demand is strong for the season. Central-station business is very promising, statistics and indices showing an increase of 28 per cent in power consumption for the year 1922 compared with 1921. Although appliances have been in good demand, dealers believe they overestimated the holiday trade, the conservative faction scoring again. Stocks are low, however, and demand fair. Credits continue to be rather tight, but bank deposits are increasing. Although business casualties were greater during the past year, the employment situation has been relieved most satisfactorily. Builders and building contractors are confident of another successful year and many large undertakings are planned.

Busy with Inventories

St. Louis.—The usual after-the-holidays recession in sales obtained during the week, merchandising being exceptionally quiet and many industrial concerns being busy with inventories. However, dealers' and jobbers' stocks of merchandise were considerably reduced by the holiday buying, and replacement orders are now being made. Prospects for power-apparatus sales during the coming year are excellent, and a large quantity of industrial building is planned. It is indicative of the general improvement in manufacturing that Federal Reserve Bank reports for this district show increases in November, 1922, as compared with November, 1921, of 30 per cent in industrial consumption of central-station power, of 7 per cent in sales of boots and shoes, of 38 per cent in stove sales, 42 per cent in wire-rope sales, 30 per cent in steel output, 47 per cent in flour production, 20 per cent in furniture and 24 per cent in electrical goods. Similar increases are reported in virtually all other lines of industry. The fundamental and underlying conditions are good. There is virtually no involuntary non-employment, agricultural conditions are promising and farm prices are getting nearer their proper relative level, profits are again appearing, old debts are being liquidated, money rates are easier, and there is general confidence in the future.

Collections Slightly Slower

New Orleans.—Collections are slightly slower than they were one month ago. This is largely due to the fact that residential construction has been in the lead, and electrical installations in residences are made almost entirely by the "curbstone contractors" who are so eager for jobs that they are apt to underbid on them and have trouble meeting their bids. Business in electrical devices has been seriously injured by the department stores. These establishments have made "leaders" of electrical equipment, selling at cost, below cost or so near to cost that a profit cannot be considered. This situation has kept electrical dealers from stocking heavily and from pushing devices on the market. Their advertising, they reason, would simply go to increase the sales of the department stores.

St. Paul-Minneapolis.—Central-station business is at a standstill with no construction of new power or telephone lines. Stocks of small-size conduit are slightly bettered by recent shipments. Better calls for wiring devices and lamps are reported. House wiring is very active. The electrical industry generally has just had the most favorable year since the war. Commercial fixtures are moving quickly.

Salt Lake City.—A survey of a dozen or more representative wholesale lines shows an increase in sales ranging from 10 to 15 per cent for November, 1922, over the same month in 1921. Jobbers of electrical merchandise have planned their budgets for the new year on conservative lines but with a view of handling a larger volume of trade. January, 1923, finds jobbers in a healthy condition. As to stocks, there are few shortages. There is some non-employment, but pending construction will furnish work for all as soon as winter has passed.

Denver.—Complete returns on Christmas business in Denver and the surrounding territory bear out conditions reported just prior to the holidays. Buying started slowly in electrical lines and sales records showed an immediate jump when a co-operative advertising campaign was started in the papers.

Demand, Supply and Price Trend of Eighteen Commodities as Sold in Fourteen Cities

Explanation:
Demand: Steady, Slow or Active
Supply: Normal, Low or High
Price Trend: Firm, Decreasing or Increasing

Next Week
Reports will include
Heaters, Batteries and Tape

	Wire	Armored Cable	Conduit	Transformers	Poles	Pole Line Hardware	Porcelain	High Tension Equipment	Fuses	Meters	Switches	Wiring Devices	Lamps	Commercial Fixtures	Motors	Heating Appliances	Radio	Washers, Cleaners
New York																		
Demand	Act.	Act.	Act.	Act.	Slo.	Slo.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Sdy.	Slo.	Sdy.	Sdy.
Supply	Nml.	Hi.	Low	Low	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Hi.	Nml.
Price trend	Inc.	Inc.	Inc.	Frm.	Inc.	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Inc.	Frm.	Frm.	Frm.	Frm.	Dec.	Frm.
Chicago																		
Demand	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Sdy.	Sdy.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Hi.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Frm.	Inc.	Frm.	Frm.	Inc.	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Dec.	Frm.
Boston																		
Demand	Act.	Act.	Act.	Act.	Slo.	Slo.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Sdy.	Slo.	Sdy.	Sdy.
Supply	Nml.	Hi.	Low	Low	Low	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Hi.	Nml.
Price trend	Inc.	Inc.	Inc.	Frm.	Inc.	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Inc.	Frm.	Frm.	Frm.	Frm.	Dec.	Frm.
Atlanta																		
Demand	Act.	Slo.	Act.	Sdy.	Slo.	Act.	Slo.	Slo.	Act.	Slo.	Act.	Act.	Act.	Act.	Slo	Act.	Act.	Slo.
Supply	Low	Low	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.
Cleveland																		
Demand	Act.	Sdy.	Act.	Act.	Act.	Act.	Slo.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Slo.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Hi.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.
Price trend	Inc.	Frm.	Inc.	Inc.	Frm.	Frm.	Dec.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.
St. Louis																		
Demand	Sdy.	Sdy.	Sdy.	Sdy.	Slo.	Slo.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.
Price trend	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.
New Orleans																		
Demand	Slo.	Sdy.	Act.	Act.	Act.	Act.	Slo.	Slo.	Sdy.	Sdy.	Act.	Act.	Act.	Act.	Act.	Slo.	Slo.	Slo.
Supply	Low	Nml.	Low	Low	Low	Low	Low	Low	Nml.	Nml.	Hi.	Low	Nml.	Nml.	Low	Nml.	Hi.	Hi.
Price trend	Inc.	Frm.	Inc.	Frm.	Inc.	Inc.	Inc.	Frm.	Frm.	Frm.	Frm.	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.
St. Paul-Minneapolis																		
Demand	Sdy.	Slo.	Act.	Sdy.	Slo.	Slo.	Slo.	Slo.	Sdy.	Sdy.	Slo.	Act.	Act.	Act.	Slo.	Slo.	Act.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Dec.	Frm.	Frm.
Salt Lake City																		
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Slo.	Act.	Sdy.	Slo.	Act.	Sdy.	Slo.	Act.	Act.	Slo.	Sdy.	Slo.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Low	Nml.	Hi.	Nml.	Nml.	Low	Hi.	Nml.	Nml.	Low	Nml.	Hi.
Price trend	Inc.	Frm.	Inc.	Frm.	Inc.	Inc.	Inc.	Frm.	Frm.	Frm.	Frm.	Inc.	Frm.	Inc.	Frm.	Frm.	Dec.	Frm.
Denver																		
Demand	Act.	Act.	Act.	Slo.	Slo.	Slo.	Act.	Slo.	Sdy.	Slo.	Sdy.	Sdy.	Act.	Act.	Slo.	Slo.	Act.	Sdy.
Supply	Nml.	Nml.	Low	Low	Nml.	Nml.	Low	Low	Hi.	Nml.	Low	Nml.	Hi.	Hi.	Nml.	Nml.	Hi.	Low
Price trend	Inc.	Inc.	Inc.	Frm.	Frm.	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Inc.	Frm.	Frm.	Frm.	Frm.	Dec.	Frm.
San Francisco																		
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Sdy.	Act.	Sdy.	Slo.
Supply	Low	Nml.	Low	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Hi.	Hi.	Nml.
Price trend	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Inc.	Frm.	Inc	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.
Portland-Seattle																		
Demand	Sdy.	Slo.	Act.	Act.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Sdy.	Act.	Sdy.	Sdy.	Act.	Act.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Hi.	Hi.
Price trend	Inc.	Inc.	Inc.	Frm.	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.	Inc.	Frm.	Frm.	Frm.	Frm.	Frm.	Frm.

Those jobbers and dealers who tied in with the campaign obtained splendid results. Five leading jobbers report all seasonal merchandise moved, including large quantities of staples such as flatirons and curling irons. Tree-lighting outfits have been cleaned out for first time since the war. It is conservatively estimated that Christmas sales were 50 per cent better than in the previous year. Depletion of stocks has assisted in taking annual inventories. Replacement will take place gradually, looking toward increased sales again in early spring. On the whole, jobbers' stocks are low, which with average demand will give good orders to manufacturers in all lines. The motor market is inactive.

San Francisco.—A 50 per cent increase in the value of building permits was the average registered by California cities in 1922 over 1921. Total for year, estimated: Los Angeles, $120,000,000; San Francisco, $50,000,000, and Oakland, $25,000,000. Next year is expected to show a similar increase, but this may be limited by labor and raw-material shortages.

Jobbers report a big year in sales volume, ranking close to the two post-war years, but one comparatively low in gross profits owing to keenly competitive conditions, mainly caused by overproduction and diverted efforts by former war factories. A résumé of Christmas sales shows a good movement in smaller appliances, somewhat better than last year, but a rather poor sale for larger appliances, despite special appeals to holiday purses. Several manufacturers are planning early spring campaigns to balance the usual seasonal lull in building and to endeavor to put retail sales in better proportion with construction. Dealers' business has not kept pace with the contractors.

Portland-Seattle.—Electrical jobbing houses have been closed for the most of the holiday week for inventory purposes. They report business for the past year to have been very good, and Christmas trade is estimated to be from 30 to 50 per cent better than a year ago. Holiday lines were practically cleaned out and hold-over stocks are small. In any case this satisfactory condition is attributed to more careful buying than formerly. There has been a great deal of electrical contracting work during the past year due to the large amount of building in this section, but much of this business has been taken on a close margin which is not conducive to a healthy financial condition. Electrical dealers are apparently in a somewhat better condition, and one of the leading firms reports that December will show the best monthly record in their history. An active demand and a low supply continue in conduit.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

New Production Record Made by Philadelphia Wire Firm

The average weekly production of the Philadelphia Insulated Wire Company, Philadelphia, from the period of July 1 to Dec. 15 was 108,970 lb., according to officials of that company. This is a new high record for the firm. In 1917, the best previous year in its history, the average weekly production, based on the entire year, was 70,000 lb. In 1921 the average weekly production over the period of July 1 to Dec. 15 was 21,600 lb. The company's total production for 1922, it is estimated, was 4,500,000 lb., which was approximately 1,500,000 lb. in excess of the 1917 figure.

Pettingell-Andrews Adds to Line

The Pettingell-Andrews Company, Boston, has taken a territorial agency for the "Yale" line of electric flashlamps, manufactured by the Yale Electric Corporation, Brooklyn, N. Y. This house will also distribute the "Thor" vacuum cleaner of the Hurley Machine Company, Chicago, in addition to other products of this manufacturer as hitherto jobbed by the Boston company.

To Sell "A & F" Heating Material

In order to provide a better service and allow undivided attention to manufacturing, the Arthur-Fowler Company has concluded an agreement with the Washington Electric Supply Company of Spokane for the distribution of "A & F" range boiler heaters, flexible tank covers, "Enamet" covers, utility tanks and its entire line of heating and insulating material.

The Arthur-Fowler Company reports a remarkable growth of sales of plastic water heaters for the year 1922 and an increase of over 200 per cent in the sale of utility tanks and range boiler covers.

S. A. Woods Motor Line Enlarged

Motors up to and including 50-hp. rating in polyphase designs are now being marketed by the S. A. Woods Machine Company, Boston, which has been expanding its business steadily during the past year. To a representative of the ELECTRICAL WORLD M. F. Fitch, sales manager of the motor division, stated recently that within the year the factory organization has been increased in size and that a better volume of business was enjoyed than was the case in 1921. Despite some difficulties in the supply of raw material, motors are being manufactured for stock as well as for immediate distribution, and no orders have been lost during the year because of inability to make specified deliveries. Plans are in effect to increase the company's sales representation in the Middle West and on the Pacific Coast. Mr. Fitch declared that the outlook for 1923 is excellent in the motor field.

Black & Decker Announce Drill Price Reductions

Following a reduction from $39 to $28 in the price of the Black & Decker quarter-inch portable electric drill on Nov. 10, the Black & Decker Manufacturing Company announces further cuts on certain popular items which are now being manufactured in such quantities as to make the following reductions possible:

Item	Old Price	New Price	Reduction
Quarter-inch drill	$39	$28	$11
Half-inch special	85	68	17
Bench drill stand	33	28	5
Post drill stand	36	32	4
Six-inch electric bench grinder	56	38	18

Walker & Pratt Appointment

J. F. Senior has been appointed sales representative of the Walker & Pratt Manufacturing Company, Boston, with headquarters at Omaha, Neb. He will cover the Middle West. The Southeastern district will be covered by E. H. Beyersdorfer, with headquarters at Cincinnati. The company's electric range business is improving, and the outlook for the new year is excellent, according to officials of the company.

Manufacturer of Royal Cleaners Reports Increasing Business

In order to provide more space for manufacturing purposes, the P. A. Geier Company, Cleveland, manufacturer of Royal electric cleaners, has moved its executive offices and service department from the St. Clair Avenue plant to another plant at 540 East 150th Street. The old office space thus available, amounting to more than 15,000 sq.ft., will hardly more than relieve congestion, and provision for enlargement is being contemplated.

The Geier company, which also manufactures vibrators, hair cutters and dryers, reports a steady increase in business in all departments. Several sales contests during the past year have given gratifying results. One of these conducted during the summer season when the appliance business normally suffers a slump, resulted in sales equal to the best month in the company's history, while a contest just concluded has so stimulated the trade as to make the present factory enlargement imperative.

General Electric Announces Bonus to Employees

The General Electric Company announced on Christmas Day that supplementary compensation equaling 5 per cent on earnings for the six months ended Dec. 31 would be paid on or about Feb. 1 to each employee receiving $4,000 or less per year who has completed five years of continuous service at the close of the year and who is still in the employ of the company at the date of distribution of the extra compensation.

The official statement says: "The payments will be made to employees in one-year 7 per cent investment bonds in ten-dollar units or multiples thereof and the balance, if any, in cash. The payment is made in bonds in the hope that it may become part of the recipients' savings instead of being used for current expenditures."

Gerard Swope, president of the company, says in the statement that no change in the policy of paying supplementary compensation will be made without one year's notice, but that a change may at any time be made without notice in the character of securities in which such supplementary compensation is paid.

Koehler Manufacturing Company Business Very Active

Excellent business is reported by the Koehler Manufacturing Company, Marlboro, Mass., in both storage-battery safety lamps and battery plates, following a recent inquiry. This company was incorporated in 1917 with H. G. Powning as president and W. S. Field as secretary and treasurer. Owing to the constantly increasing volume of business it has been necessary to expand the plant until at present it occupies a total floor space of more than 50,000 sq.ft. in four manufacturing establishments. A new two-story brick-and-steel building has recently been completed which is occupied by the tap and die and press departments. Two of the company's plants are now producing nearly 100,000 storage-battery plates weekly.

Westinghouse Springfield Factory Has Larger Force

The Westinghouse Electric & Manufacturing Company had 3,400 employees working at its East Springfield (Mass.) plant Dec. 31, or 400 more than on Nov. 1, according to Works Manager Arthur B. Reynders. Small motors have for the time being distanced automotive and radio equipment as the leading product, though an improved radio demand was noted during the pre-holiday period. Revival of industries and farm prosperity are credited with the demand for small motors which now puts orders several months ahead of production. Having used up its reserve supply of parts, the factory is building motors complete throughout, and this is partly responsible for the recent increase of the plant force over the November basis.

Frank Ridlon Head Anticipates Busy Year

Business during 1923 will show marked improvement over 1922, according to a press statement by Edward G. Young, president Frank Ridlon Company, Boston. Mr. Young reported that the sale of motors by his house had increased substantially during 1922 and that both the repair and engineering departments were fully manned during the past year. The construction department of this organization, which is one of the oldest and largest merchandisers of used and new motors in the country, is now located at Brockton, Mass., under the name of the Hallstone-Ridlon Electrical Company. Electrical supplies and appliances are distributed from this point, and business has grown so much of late that it has been difficult to handle the volume offered. Commenting on electrical price trends, Mr. Young stated that in his opinion prices cannot be expected to fall lower at present, and that an upward movement is more likely than a drop. Motor prices, he stated, are 40 to 50 per cent below the 1921 peak.

Sanford Riley Stoker Acquires Ground Coal Company

The Sanford Riley Stoker Company announces that it has acquired control of the Ground Coal Engineering Company, Chicago, designer and builder of pulverized-fuel installations. This acquirement will supplement the company's stoker work for industrial furnaces. The Ground Coal Engineering Company has been incorporated under the laws of Massachusetts and will be a subsidiary of the Sanford Riley Stoker Company with headquarters in Worcester.

It is also announced that the Underfeed Stoker Company of Canada, Ltd., Toronto, will represent the Sanford Riley interests in Canada. The headquarters of William Pestell, sales manager of the Sanford Riley firm, have been transferred to Worcester from New York City. The office of sales in the New York territory will be retained at 103 Park Avenue, New York City.

Wico Company's Business Grows

The Wico Electric Company, Springfield, Mass., has decided to occupy on March 1 the first unit (400 ft. x 90 ft.) of its new plant in West Springfield. Construction of a second unit will begin soon afterward. Figures for the first eleven months of 1922, Treasurer Edward L. Stoughton says, show an increase of 216 per cent over the corresponding period of 1921. A good business has been done in motorcycle batteries, and there has been a big expansion in magnetos for stationary engines. A new magneto for small high-speed motors has just been introduced and will soon be put in quantity production. The company purposes to double its production force on occupying its new building.

The Tri-City Electric Company, Newark, N. J., announces that the office of the president and general manager, held in the past by Joseph Spurr, has been assumed by George M. Ellis, formerly vice-president and general manager of the Mohawk Electric Supply Company, Syracuse, N. Y. H. C. Calahan, formerly of the New York office of the General Electric Company, will be associated with Mr. Ellis in the capacity of sales manager.

The Hurley Machine Company, West Twenty-second Street, Cicero, Ill., manufacturer of electric washing and ironing machines, is taking bids for a one-story addition, 61 ft. x 130 ft., to cost approximately $35,000. Edward N. Hurley is president of the company.

The Robinson Electric Company, 1135 North Fortieth Street, Philadelphia, has leased property at 809 Race Street for branch works.

The Seyler Manufacturing Company, Pittsburgh, manufacturer of pole-line and high-tension hardware, has recently broken ground for several new buildings, increasing its floor space an additional 15,000 sq.ft. The buildings in this section will be used for the manufacture of brackets and specialties.

The Monitor Controller Company, Baltimore, manufacturer of automatic motor starters and controllers, announces that it has recently appointed J. E. Wood in charge of its Cleveland sales office. The company recently opened a new sales office at 609 Whitney Central Building, New Orleans, in charge of P. E. Lehde.

The Electrical Dealers' Supply Company, Chicago, has acquired a site, 256 x 325 ft., on Diversey Boulevard, near Oakley Avenue, for a new three-story plant, estimated to cost $150,000, to be used for the manufacture of electrical fixtures and equipment. Bids will be taken at once for the structure and it is expected to be completed early in May. Samuel M. Crowen, 10 South La Salle Street, is architect. Simon Frankel is president of the company.

The Marine Electric Company, Louisville, recently reported a business of more than $100,000 for 1922, with prospects of a volume in excess of $150,000 in 1923. The company is working on installations of light, power and telephone systems.

The American Electric Service & Maintenance Company, Springfield, Mass., has practically doubled its force for repairing transformers in the last four months. A. M. Scofield, general manager, estimates that 60 per cent more business was done in 1922 than in 1921, with an even larger increase in sight for 1923. The company finds that its plant, completed last spring, is inadequate, and plans to add to its space the present Wico Electric Company factory, adjacent to its own quarters in Liberty Street, on the removal of the former to West Springfield on March 1. This will make possible the addition of new equipment to effect a more rapid and efficient service.

The Sangamo Electric Company, Springfield, Ill., announces that it has recently appointed R. H. Wilson district representative with headquarters in Tulsa, Okla., to cover southern Missouri, Arkansas, Oklahoma and a part of Texas. The company also announces the appointment of the Enterprise Electric Company, Lincoln, Neb., as its agent in that territory.

The Arrow Electric Company, Hartford, Conn., manufacturer of wiring devices, announces that Edward P. Doherty has recently joined its sales organization. Mr. Doherty will travel part of the company's Southern territory and will have his headquarters in Atlanta. He will cover South Carolina, Georgia, Florida and border towns of North Carolina. For the last four years, Mr. Doherty has sold wiring devices in all of the Atlantic Coast States.

Oldest Vulcanized-Fiber Manufacturer and Others Consolidate

Consolidation of the oldest manufacturer of vulcanized fiber in the world, the American Vulcanized Fibre Company, Wilmington, Del., with the National Fibre & Insulation Company and the Keystone Fibre Company, Yorklyn, Del., is announced. The merger was effective Jan. 1. The consolidated concern is known as the National Vulcanized Fibre Company.

J. Warren Marshall, former president of the National Fibre & Insulation Company, is president of the new company and will have charge of the production end of the business. Claude W. Sutton, who was president of the American Vulcanized Fibre Company, is vice-president and in charge of sales.

The American Vulcanized Fibre Company was formed in 1873, only four years after the process of vulcanizing fiber was discovered, and was responsible for the first commercial production of this commodity and for its adaptation to many uses. The National Fibre & Insulation Company came into existence in 1904, and the Keystone Fibre Company two years later. The consolidation was brought about by an outright purchase of the assets of the American Vulcanized Fibre Company by the shareholders of the National Fibre & Insulation Company. The Keystone Fibre Company was a selling agency only, operated by the National Fibre & Insulation Company. Economics of management and a notable strengthening of marketing service will be effected by a joining of facilities, it is expected. The central offices of the National Vulcanized Fibre Company are at Wilmington, Del.

Foreign Trade Notes

EXTENSION TO ELECTRIC SYSTEM IN BAURU, BRAZIL.—A loan of 1,500,000 milreis has recently been floated by the Companhia Paulista de Forza e Luz, *Commerce Reports* states, for the purpose of increasing its service in the northeastern section of the State of São Paulo. The proposed work includes a 2,000-hp. hydro-electric generating unit for the power plant at Bauru, a 60,000-volt transmission line from Salto do Avanhandava on the Tiete River to Bauru, and three substations, one of 1,000 kw. capacity and two of 2,000 kw., and additional distribution lines.

COMPANY FORMED TO INSTALL AN ELECTRIC PLANT IN JUTLAND, DENMARK.—A company will be formed on a co-operative plan, the central organization to be known as the Sonder Jylland Hojspaendings Vaerk, *Commerce Reports* states, to erect a large power station at Aabenraa to supply electricity in South Jutland. Money for the proposed plant has been assured through the assistance of the State.

ELECTRIC PLANT PROPOSED FOR COBDOGLA, AUSTRALIA.—A scheme has been submitted to the South Australian government for the erection of a central power plant at Cobdogla to supply electricity for all the Murray River settlements between Cadell and Chaffey, a distance of about 170 miles. It is proposed to install a plant at Cobdogla to extract alcohol from wood fuel and use it for motive power for the proposed plant. The Adelaide Electric Supply Company is also considering supplying electricity in this district from its plant at Osborne, or in case the Moorlands lignite deposit proves to be a paying proposition a power station may be established at Moorlands. The distance from Osborne to Cobdogla is about 100 miles, and from Moorlands to Cobdogla about 80 miles. This proposal has nothing to do with the project for developing the water power of Murray River and carrying out water conservation works at Lake Victoria, the Hurme Reservoir, Jorumbarry and Wentworth, which, according to the annual report of the Murray River Commission, has already cost £1,255,141.

FOREIGN TRADE CONVENTION.—The tenth national foreign trade convention of the National Foreign Trade Council will be held at New Orleans on April 25, 26 and 27, 1923, it was announced by O. K. Davis, secretary of the council. As in former years, leading foreign traders from every part of the United States and every line of industry, as well as a considerable number of business men from foreign countries, will be in attendance at the convention.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase or agency is desired in Italy (No. 4,841) for small radio receiving sets and apparatus.

An agency is desired in Norway (No. 4,861) for electric vibrators (massage) and wireless-telephone apparatus.

An agency is desired in Hungary (No. 4,865) for medium-priced automobiles and automobile accessories, including self-starters, dynamos and self-igniters, etc.

Purchase is desired in Italy (No. 4,875) of electric bulbs and other electrical accessories for house and office use and radio receiving sets.

An agency is desired in Norway (No. 4,883) for radio telephones.

Purchase or agency is desired in Italy (No. 4,887) for adjustable electric reading lamps and shades for residences.

An agency is desired in Mexico (No. 4,909) for electrical supplies and machinery and automobile supplies.

An agency is desired in Chile (No. 4,910) for electrical machinery, construction material and railway supplies, etc.

An agency is desired in Switzerland (No. 4,912) for electric washing machines.

Purchase is desired in Switzerland (No. 4,766) of mica and micanite, insulating varnish and synthetic resins for insulating.

Purchase is desired in Australia (No. 4,787) of electric lighting plants for country use of 1½ hp. up and of farm-pumping engines.

Purchase is desired in Turkey (No. 4,808) of household refrigeration plants, particularly those electrically operated.

Purchase is desired in Mexico (No. 4820) of X-ray units.

Purchase is desired in Mexico (No. 4,826) of electric motors, alternating-currents, and planing machinery for a sawmill.

Purchase and agency is desired in Poland (No. 4,829) of table telephone apparatus, copper wire, lead-covered cable, dry batteries and storage batteries.

Purchase is desired in Switzerland (No. 4,833) of friction and rubber insulating tapes.

Purchase is desired in Spain (No. 4,821) of rails, switches, trolley wire and machinery for an electric car-line repair shop.

NEW TELEPHONE SYSTEM FOR CHINA.—According to advices from Consul Carlton bids will soon be asked for the construction of a modern telephone system in Amoy City, South Fukien, China, to cost about $400,000.

New Apparatus and Publications

OIL ENGINES. — The De La Vergne Machine Company, foot of East 138th Street, New York City, is distributing bulletin No. 180, covering its type "SI" oil engines. Bulletin No. 181 describes its vertical Diesel engine type "SI."

MECHANICAL STOKERS AND FURNACE EQUIPMENT. — The Combustion Engineering Corporation, 43 Broad Street, New York City, has issued a booklet which gives a description of all its products.

CAST-STEEL VALVES.—"Reading Cast-Steel Valves" is the title of a circular issued by the Reading Steel Casting Company, Inc., Bridgeport, Conn., in which it describes a new line of "Reading" cast-steel gate valves recently placed on the market. Circular No. 2 covers the "P. & C." new bronze union-bonnet renewable-disk globe and angle valves, and No. 3 the "P. & C." bronze regrinding union-bonnet globe and angle valves.

LABOR-SAVING TOOLS.—The Paragon Power Specialties Company, Hartford, Conn., is distributing a booklet covering the "Paragon" labor-saving tools for the boiler room.

RADIO DETECTOR.—The Hutchinson Radio Company, 342 Madison Avenue, New York City, has recently placed on the market a radio detector under the name of "Phonophane."

WATER-TUBE BOILERS.—The George T. Ladd Company, First National Bank Building, Pittsburgh, is distributing bulletin No. 20, covering the "Ladd" water-tube boilers. Bulletin No. 21 issued by the company gives a supplementary description of its large water-tube boilers installed at the River Rouge plant of the Ford Motor Company.

PULVERIZED-FUEL SYSTEMS. — The Combustion Engineering Corporation, 43 Broad Street, New York City, is distributing a leaflet entitled "A Record of Performance with 'Lopulco' Pulverized-Fuel Systems," showing boiler tests made with powdered coal in two large power stations.

STEAM-JET AIR PUMPS.—Bulletin No. 116 issued by the Wheeler Condenser & Engineering Company, Carteret, N. J., covers its various types of steam-jet air pumps.

METERS.—The Bailey Meter Company, 2015 East Forty-sixth Street, Cleveland, is distributing bulletin No. 33 describing the "Bailey" fluid meters for steam and water. Bulletin No. 7 calls attention to its various products, including boiler panel, multi-pointer gage, ash-pit loss recorder, etc.

SMALL MOTORS.—The Master Electric Company, 438 First Street, Dayton, Ohio, is manufacturing a new motor in sizes from ¼ hp. to 1½ hp. Its lines of "Master" motors is from ¼ hp. to 1½ hp. The company has issued its 1923 data book and price list, covering its products.

GEAR-SPEED REDUCERS.—The Jones Foundry & Machine Company, 4,401-51 West Roosevelt Road, Chicago, has issued catalog No. 26, covering the "Jones" spur gear-speed reducers.

RADIO SUPPLIES.—"Rasco Has It" is the title of catalog No. 8 issued by the Radio Specialty Company, 96-98 Park Place, New York City, covering its line of "Rasco" radio supplies.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

CLAREMONT, N. H.—The installation of a new street-lighting system is under consideration by the Selectmen.

WAKEFIELD, MASS. — Bonds to the amount of $50,000 have been authorized to place the high-tension lines underground. The Edison Electric Illuminating Company of Boston will expend $135,000 to put its high-tension lines underground from the Woburn station to the Wakefield line. The town will place the wires underground from the Wakefield line to the distributing station.

NORWICH, CONN.—The Eastern Connecticut Power Company is negotiating for the plants and system of the People's Light & Power Company and the Danielson & Plainfield Gas & Electric Company, which operates in Danielson, Plainfield, Brooklyn, Dayville and several other towns in that vicinity.

STAFFORD SPRINGS, CONN. — The Rockville-Willimantic Lighting Company contemplates extending its service to West Stafford, Forestville and Orcutville, a distance of about 3 miles.

Middle Atlantic States

BROOKLYN, N. Y.—The stockholders of the Brooklyn Edison Company voted to increase in capital stock from $30,000,000 to $50,000,000. Of the proceeds $15,000,000 will be utilized to erect a new generating station at Hudson Avenue and the East River, to have an ultimate capacity of 400,000 kw. and other power-plant extensions. In addition the company will expend an average of $500,000 a month during 1923 for new machinery and equipment for existing power houses, substations and extensions to transmission lines.

GLENS FALLS, N. Y. — Arrangements are being made by E. J. Worden to erect an electric power plant on Canada Street. The surplus water of the Lake George Water Company will be used to generate electricity, which will be available in emergencies on the Worden properties.

LONG ISLAND CITY, N. Y.—Motors, controllers and other electric power equipment will be installed in the proposed plant of the Latham Lithographing & Printing Company, 32 West Forty-second Street, New York, to be erected on Woodside Avenue, at a cost of about $1,000,000.

OGDENSBURG, N. Y.—The Ogdensburg Paper Company will install electric power equipment in connection with a proposed addition to its plant, to cost about $150,000.

RUSH, N. Y.—The question of having the transmission line extended from East Henrietta to Rush is under consideration. The cost is estimated at about $6,000.

CAMDEN, N. J. — The Philadelphia & Reading Railway Company will build an electric generating plant at its local terminal, now in course of construction, to cost about $3,000,000. Four electrically operated ferry slips will be installed.

ELIZABETH, N. J.—Motors, controllers and other electric equipment will be installed in the printing plant to be erected by the Elizabeth *Daily Journal*, 74 Broad Street, to cost about $200,000. C. Godfrey Poggi, 275 Morris Avenue, is architect.

NEWARK, N. J.—Bids will be received by the Board of Education, City Hall, until Jan. 10 for electrical work in the addition to the Milford school. Robert D. Argue is secretary.

WILDWOOD, N. J.—The Ottens Ice & Cold Storage Company will install electric power equipment in its proposed ice and cold-storage plant, to cost about $70,000. Mark B. Reeves, Wildwood Trust Building, is architect.

ALLENTOWN, PA.—The Pennsylvania Power & Light Company is negotiating for the purchase of a number of power companies in Northumberland County and will merge the systems. Additional transmission and distributing lines will be erected.

DRUMS, PA.—The Pennsylvania Power & Light Company will build a transmission

line to Drums for local service. A line also will be erected from Shamokin to a substation at Island Park.

ERIE, PA.—A permit has been granted to the Erie County Milk Association to erect a new power house on Peach Street between Twentieth and Twenty-first Streets.

LEBANON, PA. — The Keystone Macaroni Company will build a one-story power house at its local plant.

LEMOYNE, PA.—The West Shore Lumber Company will build a one-story power house, 40 ft. x 60 ft.

PHILADELPHIA, PA.—The Philadelphia Electric Company has acquired the Penn Electric Light Company and plans extensions and improvements.

YORK, PA.—The installation of municipal electric plant, to cost about $250,000, is reported to be under consideration by the City Council.

APPOMATTOX, VA.—Arrangements are being made to rebuild the municipal light and power plant, recently destroyed by fire. C. A. Hancock is chairman of the committee.

WASHINGTON, D. C.—Bids will be received by the General Purchasing Officer, Panama Canal, until Jan. 19 for electrical and mechanical equipment, including lightning arresters, electrical wire, etc. (Circular 1506).

WASHINGTON, D. C. — Bids will be received by the Chief Signal Officer, United States Army, until Jan. 12 for telephone supplies (Circular PR-13538-1 CP). Also, until Jan. 11 for 2,400 dry batteries (Circular PR-13260-2CP).

North Central States

BAD AXE, MICH. — The Great Lakes Electrical Company, recently organized, plans to erect a transmission line to furnish service in this section, including Brown City, Mayville and Elkton. Power will be supplied by the Detroit Edison Company, which will extend its transmission line from Port Huron to a point near Brown City. John Clark, Bad Axe, heads the new company.

GRAND RAPIDS, MICH.—The Consumers' Power Company contemplates extensions and improvements to its local system, to cost about $400,000.

LANSING, MICH. — The Durant Motor Company contemplates doubling the capacity of the power plant at its local works.

MOTTVILLE, MICH.—The Middle West Utilities Company, 72 West Adams Street, Chicago, has acquired a power site on the St. Joseph River for a power plant, to cost $400,000. It will be operated by the Michigan Gas & Electric Company, a subsidiary.

PORT HURON, MICH.—The New Egyptian Portland Cement Company, Ford Building, Detroit, plans to install a power house in connection with its new local plant.

DELPHOS, OHIO.—The Northwestern Ohio Power Company is erecting a new electric transmission line from the local plant to Van Wert, where the current will be distributed in Convoy and Ohio City.

GEORGETOWN, KY. — The Kentucky Traction & Terminal Company is planning to rebuild its local electric substation, recently destroyed by fire.

PADUCAH, KY.—Plans are being prepared by the Pillsbury-Becker Engineering Company, 119 South Eleventh Street, St. Louis, for an ice-manufacturing plant for the Paducah Electric Company, to cost about $700,000.

STEFF, KY. — The Spring Lick (Ky.) Coal Company, recently organized, contemplates the installation of electric power and mechanical equipment at its properties near Steff. George W. Heheman, Prospect, is president.

MOUNT VERNON, ILL. — The Mount Vernon Car Manufacturing Company will install electric power equipment at its proposed addition, to cost about $250,000.

CHETEK, WIS.—The Wisconsin Hydro-Electric Company, Amery, has acquired the property of the Chetek Light & Power Company.

MARSHFIELD, WIS.—To meet the increasing demand for electrical service extensive additions will have to be made to the municipal electric plant. The installation of a 7,500 kw. turbo-generator unit is under consideration. The question of securing electricity from the transmission systems of the Wisconsin-Minnesota Light & Power Company, Eau Claire, or the Wisconsin Valley Electric Company, Wausau, is also under consideration.

STEVENS POINT, WIS.—Plans are being prepared by L. E. De Guere, Wisconsin Rapids, engineer, for a two-story paper mill and hydro-electric plant, to cost about $300,000.

STRATFORD, WIS.—The Stratford Light & Power Company contemplates building a hydro-electric plant with steam auxiliary power station and distribution system, to cost about $65,000.

THREE LAKES, WIS.—The Council is considering issuing bonds for the installation of a municipal electric lighting system, energy to be secured from the municipal electric plant at Eagle River.

TOMAH, WIS.—The plant and holdings of the Tomah Light & Power Company have been acquired by the Middle Wisconsin Power Company. The new owners, it is understood, will connect its lines with the transmission system of the Central Wisconsin Power Company and will distribute electricity to a number of towns in this vicinity.

RED WING, MINN.—The City Council has engaged L. P. Wolf, St. Paul, consulting engineer, to prepare preliminary plans for a municipal electric plant and pumping station for waterworks and also for an ornamental lighting system. The cost is estimated at about $350,000.

ST. PAUL, MINN.—The St. Paul Gas Light Company is reported to have purchased an island in the Mississippi River at the edge of the city on which it proposes to build a hydro-electric plant, to cost about $1,250,000.

ST. PAUL, MINN.—A ten-year construction plan involving an expenditure of $80,000,000 has been announced by the Northern States Power Company. Work will soon start on the first unit, which is a new steam-driven power plant on the Mississippi River at St. Paul. The second unit, a hydro-electric plant, will be located on St. Croix River, near here, and will be built in 1923. The cost of the two plants is estimated at $10,000,000.

DAVENPORT, IOWA.—The Rural Power Company has been granted franchises to erect electric transmission lines on a number of roads in Scott County.

EXCELSIOR SPRINGS, MO.—The North Missouri Power Company, which has acquired the property of the Excelsior Springs Water, Gas & Electric Company and plants in several other towns in this part of the state, is considering the construction of a new power plant.

FRANKLIN, MO.—The Missouri, Kansas & Texas Railroad Company, St. Louis, has plans under way for the erection of a power house, in connection with a new engine house and shops, to cost about $85,000.

KANSAS CITY, MO.—The Santa Fé Railway Company plans to build a series of power plants in connection with the proposed electrification of its main trunk line. The Keese Engineering Company, Los Angeles, is preparing preliminary plans.

RUTLEDGE, MO. — The citizens have voted to secure electricity for local service from the Edina (Mo.) Light Company.

LINCOLN, NEB.—The Continental Gas & Electric Company, which has acquired the property of the Lincoln Gas & Electric Company, is preparing plans for an addition to the local power plant.

Southern States

GREAT FALLS, S. C.—The Great Falls Power Company has increased its capital stock from $17,000,000 to $20,000,000, part of the proceeds to be used for extensions and improvements.

ATHENS, GA.—The Georgia Brick Company will rebuild its power house and manufacturing plant, recently damaged by fire, causing a loss of about $40,000.

JACKSONVILLE, FLA.—The City Commission will install a new lighting system on Twenty-sixth Street from Myrtle Avenue to Davis Street.

CHATTANOOGA, TENN. — The Dixie Spinning Mill, Inc., will build a power house in connection with its proposed plant, comprising nine mill units, to cost about $5,000,000.

CHATTANOOGA, TENN.—Plans have been completed by the Western Union Telegraph Company, 195 Broadway, New York City, for the construction of a general repair plant in Chattanooga, to cost about $250,000.

KNOXVILLE, TENN. — The Cherokee Brick Company, recently organized, will build a power house in connection with its proposed plant to be erected near the city, to cost about $250,000. J. Albert Robbins is president.

PIKEVILLE, TENN.—The Pocahontas & Sewanee Coal Company will install electric power equipment at its mines.

HALEYVILLE, ALA.—Plans are under consideration for the installation of a municipal electric plant and waterworks system. The equipment will include two 100-hp. engines and two 65-kw. generators.

BURBANK, OKLA.—Preliminary plans are under way for extensions and improvements in the municipal electric plant and system.

CLINTON, OKLA.—Plans are being prepared by V. V. Long & Company, Colcord Building, Oklahoma City, engineers, for extensions to the municipal electric light plant and waterworks system.

NOWATA, OKLA.—The proposal to issue $111,000 in bonds for new pumps, a 2,000,000-gal. reservoir, power plant and mains will be submitted to the voters on Jan. 23.

CANTON, TEX.—A bond issue of $50,000 has been sold, the proceeds to be used for a municipal electric plant and waterworks.

DALLAS, TEX.—Plans for the proposed municipal public market in Dallas provide for a power house and ice-manufacturing and refrigerating plant. The cost is estimated at $500,000. Charles L. Sanger is chairman of the municipal market committee.

FORT WORTH, TEX.—A bond issue of $250,000 is being arranged for extensions to the municipal light and power system.

FORT WORTH, TEX.—W. P. Gilbert will install electric power equipment in his proposed ice-manufacturing plant in the Hemphill Heights section, to cost about $75,000, of which $45,000 will be used for machinery.

PERRYTON, TEX. — The citizens have voted to issue $100,000 in water and light bonds.

WICHITA FALLS, TEX.—The installation of an electric power plant to supply electricity for the ornamental lighting system and street lamps is under consideration.

Pacific and Mountain States

WINTHROP, WASH.—The Upper Methow Valley Light & Power Company, recently organized, plans to supply electricity for lamps and motors in the Methow Valley.

BANDON, ORE.—The Council has authorized a special election to vote on the proposal to issue $40,000 in bonds for extension to the municipal hydro-electric system.

ALHAMBRA, CAL. — An ornamental street-lighting system will be installed on Garfield Avenue between Hellman Avenue and Ramona Boulevard.

AZUSA, CAL. — The Azusa Ice & Cold Storage Company plans to rebuild its power house and plant, recently destroyed by fire, causing a loss of about $100,000.

FORTUNA, CAL. — John F. Williams, Fortuna, and associates have applied to the State Water Commission for permission to construct a hydro-electric plant on the North Fork of the Eel River, Mendocino County, with initial installation of 22,600 hp., to cost about $2,000,000.

FULLERTON, CAL. — The Placentia Orange Growers' Association will install electric power equipment at its proposed local precooling and refrigerating plant, to cost about $150,000.

GLENDORA, CAL.—The Southern California Edison Company will make extensions and improvements to its local distributing system, to cost about $20,000.

NEEDLES, CAL.—The Santa Fé Railway Company, Kerckhoff Building, Los Angeles, will install electric power equipment in connection with its proposed local ice and precooling plant, to cost about $250,000.

PETALUMA, CAL.—The Petaluma Ice & Cold Storage Company will install electric power equipment in connection with its proposed plant addition at East Petaluma, to cost about $100,000.

SAN FRANCISCO, CAL.—The lighting committee of the Board of Supervisors has recommended replacing the gas lamps on Fifth Street from Market to Mission Street with electric lamps. The committee also voted to increase the number of street lamps on Mason Street from Market to Sutter Street.

STOCKTON, CAL.—Electric power equipment will be installed in the ice and precooling plant to be erected by the Terminal Cold Storage & Warehouse Company, to cost about $250,000. N. E. McLean, 16 California Street, San Francisco, is architect.

TAFT, CAL. — Preliminary plans are under way for the installation of an ornamental lighting system on Fourth and North Streets.

TURLOCK, CAL.—The Turlock Irrigation District has applied to the State Water Department for permission to construct a hydro-electric plant on the Tuolumne River, to cost about $480,000.

WEIPPE, IDAHO.—The E. T. Chapin Pole Company, Spokane, Wash., contemplates the construction of a power house in connection with its proposed mill, to cost about $100,000.

TONOPAH, NEV.—The Bellehelen Merger Mines Company will install electric power equipment in connection with its proposed new mill, to have capacity of 50 tons a day.

Canada

WINNIPEG, MAN.—Tenders will be received by the Public Utilities Committee until Jan. 25 for three transformers for the proposed standby plant. The cost is estimated at $210,000. J. G. Glassco is manager of the Winnipeg hydro-electric system.

ST. JOHN, N. B.—The New Brunswick Electric Power Commission is considering a hydro-electric development at Nepisiquit Falls, to cost about $500,000. C. O. Foss is engineer.

STAMFORD, ONT.—The officials of the township are plannnig to have the lines of the Hydro-Electric Power Commission of Ontario extend through the township. The cost is estimated at $38,000.

TORONTO, ONT.—Plans are under consideration by the Hydro-Electric Power Commission of Ontario for another hydro-electric project on the Niagara River, to develop an additional 50,000 hp. Adam Beck is chairman of the commission.

MONTREAL, QUE.—The Southern Canada Power Company contemplates another large hydro-electric development on the St. Francis River next year, to develop about 30,000 hp.

MONTREAL, QUE.—Plans have been prepared by the Back River Power Company, care of J. R. Walker, 35 Common Street, for construction of a dam across the Rivière des Prairies, just below Visitation Island, to develop 50,000 hp. T. Pringle & Son, 20 St. Nicholas Street, are engineers.

Electrical Patents

Announced by U. S. Patent Office

(Issued Dec. 12, 1922)

1,438,636. TERMINAL PROTECTOR FOR ELECTROLYTIC CONDENSERS AND RECTIFIERS; J. Coulson, Wilkinsburg, and C. J. Rottmann, Pittsburgh, Pa. App. filed March 13, 1918. Water vapor maintained about the electrode terminals.

1,438,646. SWITCH AND FUSE BOX; H. F. Hitner, Pittsburgh, Pa. App. filed Dec. 9, 1920. Multiple-fuse blocks with switch for each block.

1,438,649. MOTOR-CONTROL SYSTEM; H. D. James, Edgewood Park, Pa. App. filed March 13, 1920. Dynamic braking of series electric motors.

1,438,690. TROLLEY SWITCH; A. Bogdanski, Cohoes, N. Y. App. filed Sept. 27, 1922. Facilitates passage of trolley over switch.

1,438,722. ELECTROLYTIC ANODE; R. A. Price, Berwyn, Ill. App. filed March 7, 1921. Anode hook and suspending bar to reduce high-resistance contact.

1,438,728. ELECTRIC STARTING MOTOR; H. Steinhart, Stuttgart, Germany. App. filed Dec. 31, 1919. Two-circuit automobile starter.

1,438,732. TELEPHONE EXCHANGE SYSTEM; W. C. Weaver, East Orange, N. J. App. filed Dec. 27, 1918. Toll-line operator's signal.

1,438,736. TELEPHONE SYSTEM; S. B. Williams, Jr., Brooklyn, N. Y. App. filed Jan. 16, 1920. Automatic switches for interconnecting lines.

1,438,742. ELECTRIC IRON; G. R. Blakesley, Edgerton, Wis. App. filed Dec. 2, 1920. Switch under handle for controlling current.

1,438,743. TELEPHONE-EXCHANGE SYSTEM; E. H. Clark, New York, N. Y. App. filed Oct. 4, 1918. Automatic system terminate in semi-automatic exchange.

1,438,744. TELEPHONE EXCHANGE SYSTEM; E. H. Clark, New York, N. Y. App. filed Feb. 7, 1919. Indicator for automatic system connected to manual exchange.

1,438,751. CONDUIT FOR THERMO-TEMPERATURE CIRCUITS OF GRAIN TANKS; L. H. Des Isles, Chicago, Ill. App. filed July 6, 1918.

1,438,753. RHEOSTAT; H. A. Douglas, Bronson, Mich. App. filed June 1, 1922. Spiral winding with rotating contact.

1,438,758. MACHINE SWITCHING DEVICE; C. L. Goodrum, New York, N. Y. App. filed Feb. 24, 1919. Automatic or semi-automatic type.

1,438,789. RELEASING DEVICE FOR OVERLOAD SWITCHES; L. Schon, Essen-on-the-Ruhr, Germany. App. filed Dec. 3, 1920. Time-limit device.

1,438,799. INCRUSTED METAL DESIGN ON CERAMIC SUBSTANCES AND PROCESS OF MAKING SAME; E. Warrin, Upper Montclair, N. J. App. filed June 30, 1920. Combined etching and electroplating process.

1,438,828. METHOD AND APPARATUS FOR SELECTIVELY TRANSFERRING ELECTRICAL OSCILLATORY ENERGY; H. W. Houck, New York, N. Y. App. filed March 29, 1920. Generation, transmission and reception of oscillatory energy.

1,438,833. CONTROLLING SYSTEM FOR SIMULTANEOUSLY FIRING A NUMBER OF GUNS FROM A CENTRAL STATION; P. Kaminski, Berlin-Pankow, Germany. App. filed March 29, 1921.

1,438,841. TELEPHONE-EXCHANGE SYSTEM; A. E. Lundell and E. H. Clark, New York, N. Y. App. filed Sept. 6, 1919. Machine-switching equipment.

1,438,854. COUPLING TRANSFORMER FOR RADIO SYSTEMS; R. S. Piper, Chicago, Ill. App. filed June 15, 1922. Inductive coupling between antenna and secondary circuit.

1,438,858. INSULATING TUBING FOR ELECTRICAL CONDUITS AND METHOD OF MAKING SAME; O. Rey Zurich, Switzerland. App. filed May 1, 1919.

1,438,866. ELECTRIC RAILWAY BRAKE; W. H. Sauvage, Buffalo, N. Y. App. filed June 8, 1920. Brake operated by motor.

1,438,934. ELECTRIC REGULATION; J. L. Creveling, White Plains, N. Y. App. filed Aug. 17, 1916. Voltage regulator for generator.

1,438,936. ELECTRICAL FURNACE; A. Eimer, New York, N. Y. App. filed Aug. 24, 1921. For melting silica, quartz, etc., for molding.

(Issued Dec. 19, 1922)

1,438,938. TRANSMISSION SYSTEM; J. F. Baldwin, Jr., East Orange, N. J. App. filed March 29, 1920. Four-wire repeater telephone systems.

1,438,944. ELECTRIC REGULATOR; R. D. Conway, Chatham, N. J. App. filed July 24, 1919. Arrangement for regulating current flow in a circuit.

1,438,945. ELECTRIC REGULATOR; R. D. Conway, Chatham, N. J. App. filed July 24, 1919. Means for insuring constant flow of current over a circuit obtained by using thermionic tubes.

1,438,946. ELECTRIC REGULATOR; R. D. Conway, Chatham, N. J. App. filed Dec. 8, 1919. Means for insuring constant flow of current through a circuit.

1,438,947. ELECTRIC REGULATOR; R. D. Conway, Chatham, N. J. App. filed Dec. 9, 1919. Constant-current system controlled by thermionic tubes.

1,438,953. LIGHTNING ARRESTER; G. R. Folds, Evanston, Ill. App. filed July 12, 1919. Saw-tooth arrester construction for communication systems.

1,438,954. LIGHTNING ARRESTER FOR COMMUTATION SYSTEMS; G. R. Folds, Evanston, Ill. App. filed Nov. 12, 1919. Means for electrically separating line and ground springs.

1,438,959. AUTOMATIC TELEPHONE-EXCHANGE SYSTEM; J. W. Lattig, Bethlehem, Pa. App. filed Aug. 29, 1904. Circuit arrangement for machine switching system.

1,438,960. AUTOMATIC TELEPHONE-EXCHANGE SYSTEM; J. W. Lattig, Bethlehem, Pa. App. filed Aug. 29, 1904. Meter-control relay for recording calls.

1,438,961. PRINTING-TELEGRAPH SYSTEM; A. E. Lundell, New York, N. Y. App. filed May 25, 1918.

1,438,969. VACUUM TUBE; L. R. Spengeman, Jersey City, N. J. App. filed Sept. 17, 1918. Top of electron-tube filament held taut by spring.

1,438,974. PIEZO-ELECTRICAL VOLTAGE INDICATOR; E. C. Wente, New York, N. Y. App. filed Nov. 13, 1920. Instrument for recording wave forms of alternating current.

1,438,976. ELECTRIC REGULATOR; P. I. Wold, East Orange, N. J. App. filed June 8, 1918. Regulating motors or generators with thermionic tubes.

1,438,987. HIGH-FREQUENCY TRANSLATING CIRCUITS; L. Espenschied, Hollis, and H. A. Affel, Brooklyn, N. Y. App. filed Sept. 30, 1919. Arrangements for modulating currents of various frequencies.

1,438,988. HIGH-FREQUENCY TRANSLATING CIRCUITS; L. Espenschied, Queens, and H. A. Affel, Brooklyn, N. Y. App. filed Sept. 30, 1919. High-frequency translating circuits for modulating currents of various frequencies.

1,438,989. HIGH-FREQUENCY TRANSLATING CIRCUITS; L. Espenschied, Queens, and H. A. Affel, Brooklyn, N. Y. App. filed Sept. 30, 1919. Modulation of several frequencies by means of an arc.

1,439,016. PROJECTOR ELECTRODE; W. R. Mott, Lakewood, Ohio. App. filed July 28, 1919. For motion-picture machines.

1,439,036. VOLTAGE-REGULATING CIRCUIT; S. Suekoff, Chicago, Ill. App. filed July 10, 1920. Automatically maintains constant-voltage on storage battery.

1,439,071. SECRET-SERVICE CORD CIRCUITS; H. D. Currier, Chicago, Ill. App. filed March 20, 1915. Telephone system using link or cord circuits.

1,439,094. HEATING BAG; H. Gingras, Quebec, Can. App. filed April 17, 1922. Heating element between two stones that are surrounded by asbestos.

1,439,117. TELEPHONE INSTRUMENT; J. S. Newman, Cleveland, Ohio. App. filed Aug. 16, 1915. Relates to carbon transmitting equipment.

1,439,121. HEATING UNIT FOR SADIRONS; A. E. Reimers, Middletown, N. Y. App. filed Dec. 13, 1920. Heating element and its casing independent unit.

1,439,123. METHOD OF MAKING ELECTRICAL RESISTANCE UNITS AND THE LIKE; L. T. Richardson, New Brunswick, N. J. App. filed Oct. 27, 1920. Resistance units covered with vitreous or similar fired coatings.

1,439,124. AUTOMATIC TELEPHONE SYSTEM; R. G. Richardson, Chicago, Ill. App. filed Feb. 14, 1916. Employs finder switches for connecting calling line with a selector switch.

1,439,130. AUTO SIGNAL; O. Schwimmer, Los Angeles, Cal. App. filed Jan. 10, 1919. Indicates direction of travel.

1,439,134. MODULATING METHOD AND SYSTEM; L. J. Sivian, East Orange, N. J. App. filed April 7, 1919. Generation of oscillations having amplitude which varies according to a desired wave form.

1,439,155. STORAGE-BATTERY INSULATOR; F. J. Erickson, Minneapolis, Minn. App. filed July 14, 1921. Plate separators of rubber.

1,439,212. PORTABLE AUDIPHONE TRANSMITTER; C. E. Williams, Chicago, Ill. App. filed Nov. 5, 1920. For partially deaf people.

1,439,213. TELEPHONE-EXCHANGE SYSTEM; S. B. Williams, Jr., Brooklyn, N. Y. App. filed April 24, 1919. Interconnecting apparatus for telephone lines.

1,439,335. ELECTRIC STOVE; A. Selvatico, Milan, Italy. App. filed Aug. 13, 1921. Air circulated internally and around element and reflected against oven plate.

1,439,340. HIGH-TEMPERATURE PREHEATER FOR FLUIDS; P. St. Clair, Jr., Niagara Falls, N. Y. App. filed May 24, 1919. For various synthetic ammonia processes.

1,439,363. RECEIVING SYSTEM FOR RADIANT ENERGY; J. H. Hammond, Jr., Gloucester, Mass. App. filed Dec. 13, 1919. Insulator for supporting antenna upon marine vessel.

1,439,387. WRAPPING MACHINE; W. M. Wheildon, Ashland, Mass. App. filed Jan. 14, 1921.

1,439,404. ILLUMINATED TOOL; C. L. Cotharin, Chicago, Ill. App. filed March 11, 1922. Detachable handle contains flashlight battery and bulb.

1,439,408. FLASHLIGHT; I. L. Ferris, Bridgeport, Conn. App. filed Sept. 14, 1921. Adjustable mounting for lamp bulb to permit focusing.

1,439,427. AUTOMATIC TELEPHONE EXCHANGE; F. A. Lundquist, Chicago, Ill. App. filed July 19, 1917. Improvement in mechanical construction of line switches.

1,439,429. BATTERY HOLDER; A. S. Lyhne, Bridgeport, Conn. App. filed Feb. 12, 1921. Facilitates the changing of dry cells.

1,439,430. WEATHERPROOF BATTERY CASE; A. S. Lyhne, Bridgeport, Conn. App. filed Feb. 12, 1921. Dry-cell case for bicycles, boats, etc.

1,439,438. ELECTRIC FLUSH RECEPTACLE; W. J. Newton, Bridgeport, Conn. App. filed April 24, 1920. Adjustable wall case and outlet-box type provided with face plates.

1,439,457. STORAGE-BATTERY CLIP; H. E. Walker, Chicago, Ill. App. filed May 10, 1921.

1,439,471. INCANDESCENT LAMP; P. E. Hohl, Cleveland, Ohio. App. filed May 4, 1921. Construction facilitates insertion and renewal of filament.

1,439,480. FORMING FLANGES ON TUBES AND SIMILAR ARTICLES; G. H. Phelps, Warehouse Point, Conn. App. filed July 8, 1921. By application of resistance heating.

1,439,483. AUTOMOBILE STORAGE-BATTERY-CHARGING SYSTEM; J. A. Ritter, Lansdowne, Pa. App. filed Feb. 1, 1922.

1,439,495. RADIO RECEIVING APPARATUS; H. M. Williamson, Chicago, Ill. App. filed Sept. 25, 1922. Provided with apparatus to filter out static or foreign waves.

Directory of Electrical Associations

Printed in the First Issue of Each Volume

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co., Birmingham, Ala.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 63 East Adams St., Chicago, Ill.

AMERICAN ASSOCIATION OF OPERATING ENGINEERS. Secretary, H. C. Bristol, Calderwood, Tenn.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Executive secretary, J. W. Welsh, 8 West 40th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Colin G. Fink, Columbia University, New York City.

AMERICAN ENGINEERING STANDARDS COMMITTEE. Secretary, P. G. Agnew, 29 West 39th St., New York City.

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ARKANSAS UTILITIES ASSOCIATION. Secretary, R. I. Brown, Little Rock Railway & Electric Company, Little Rock, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, Frederic Nicholas, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, 80th St. and East End Ave., New York.

ASSOCIATION OF ELECTRAGISTS INTERNATIONAL (formerly National Association of Electrical Contractors and Dealers). Secretary, Farquson Johnson, 15 West 37th St., New York City, N. Y. Direct membership throughout the United States and Canada.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Room 413, C. & N. W. Terminal Station, Chicago, Ill.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary, Louis Kon, 65 McGill College Ave., Montreal.

COLORADO PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, Miss Minnie B. W. Baker, 900 15th St., Denver, Col.

COMMERCIAL NATIONAL SECTION, N. E. L. A. National chairman, O. K. Hogue, Commonwealth Edison Co., Chicago, Ill.

ELECTRIC CLUB OF CHICAGO. Hotel Morrison, Chicago, Ill.

ELECTRIC POWER CLUB. Executive secretary, S. N. Clarkson, Kirby Bldg., Cleveland, Ohio.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, H. E. Hackenberg, National Carbon Co., 30 E. 42d St., New York City.

ELECTRICAL MANUFACTURERS' COUNCIL. Executive secretary, Frederic Nicholas, 30 East 42d St., New York City.

ELECTRICAL SAFETY CONFERENCE. Secretary, Dana Pierce, 109 Leonard St., New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, E. Donald Tolles, 165 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Grand Central Terminal Building, New York City.

FEDERATED AMERICAN ENGINEERING SOCIETIES. Secretary, L. W. Wallace, 26 Jackson Place, Washigton, D. C.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

GEORGIA ELECTRICAL ASSOCIATION. Secretary-treasurer, W. C. Drake, Atlanta, Ga.

GREAT LAKES GEOGRAPHIC DIVISION, N. E. L. A. Secretary-treasurer, R. V. Prather, 305 Illinois Mine Workers Bldg., Springfield, Ill.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, 305 Illinois Mine Workers Bldg., Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Samuel G. Hibben, 29 West 39th St., New York City. Sections in New York, Philadelphia, Chicago and Boston. Chapters in San Francisco, Cleveland and Toronto.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary, M. G. Linn, Des Moines Electric Co., Des Moines, Iowa.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer T. T. Parker, Kansas Electric Power Co., Emporia, Kan.

KENTUCKY ASSOCIATION OF PUBLIC UTILITIES. Secretary, E. F. Kelly, Louisville Railway Company, Louisville, Ky.

LIGHTING FIXTURE DEALERS' SOCIETY OF AMERICA. Secretary, J. L. Wolf, Electrical League, Hotel Statler, Cleveland, Ohio.

MICHIGAN ELECTRIC LIGHT ASSOCIATION. Secretary, Herbert Silvester, Edison Bldg., Ann Arbor, Mich.

MIDDLE WEST GEOGRAPHIC DIVISION, N. E. L. A. Secretary-treasurer, Horace M. Davis, Bankers' Life Bldg., Lincoln, Neb.

MISSISSIPPI ELECTRIC ASSOCIATION, affiliated with the N. E. L. A. Secretary, W. A. Sullivan, Gulfport & Mississippi Coast Traction Co., Gulfport, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 315 North 12th St., St. Louis, Mo.

NATIONAL COUNCIL LIGHTING FIXTURE MANUFACTURERS. Secretary, Chas. H. Hofrichter, 233 Gordon Square Bldg., Cleveland, Ohio.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Executive secretary, T. H. Day, 59 Deerfield Ave., Hartford, Conn.

NATIONAL ASSOCIATION OF RAILWAY AND UTILITIES COMMISSIONERS. Secretary, James B. Walker, New York Transit Commission, New York City.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive manager, M. H. Aylesworth, 29 West 39th St., New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1347 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Chairman of electrical committee, Dana Pierce, 109 Leonard St., New York City. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NATIONAL SAFETY COUNCIL. Secretary, W. H. Cameron, 168 No. Michigan Ave., Chicago, Ill.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, Horace M. Davis, Bankers' Life Bldg., Lincoln, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, James A. Loring, 99 Bedford St., Boston, Mass.

NEW ENGLAND GEOGRAPHIC DIVISION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, W. J. Kreger, 47 West 34th St., New York City.

NEW YORK ELECTRICAL LEAGUE. Secretary, Albert Goldman, 555 East Tremont Ave., New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTH CENTRAL ELECTRIC ASSOCIATION (Geographic Division N. E. L. A.). Secretary, H. E. Young, Minneapolis General Electric Co., Minneapolis.

NORTHWESTERN GEOGRAPHIC DIVISION, N. E. L. A. Secretary-treasurer, George Quinan, Puget Sound Power & Light Co., Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OKLAHOMA UTILITIES ASSOCIATION. Acting secretary, O. D. Hall, Oklahoma City.

PACIFIC COAST ELECTRICAL ASSOCIATION (Geographic Division N. E. L. A.). Secretary, S. H. Taylor, 527 Rialto Bldg., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION (State Section N. E. L. A.). Secretary, H. M. Stine, 212 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, R. M. Booker, Newport News & Hampton Railway, Gas & Electric Co., Hampton, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, A. Bliss McCrum, Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, Renville H. McMann, 15 Warren St., New York City.

ROCKY MOUNTAIN ELECTRICAL CO-OPERATIVE LEAGUE. Secretary-treasurer, R. M. Bleak, Kearns Building, Salt Lake City, Utah.

ROCKY MOUNTAIN GEOGRAPHIC DIVISION, N. E. L. A. Treasurer, A. C. Cornell, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. Assistant to the president, W. L. Goodwin; secretary, J. Smieton, Jr.; treasurer, R. F. Paige, 522 5th Ave., New York City. Annual meeting second Tuesday in May; directors' meetings second Tuesday in May and November; executive committee meetings every sixty days.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOCIETY OF INDUSTRIAL ENGINEERS. Secretary, G. C. Dent, 327 So. La Salle St., Chicago, Ill.

SOUTHEASTERN GEOGRAPHIC DIVISION, N. E. L. A. Secretary, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

SOUTHWESTERN GEOGRAPHIC DIVISION, N. E. L. A. Secretary, S. J. Ballinger, San Antonio Public Service Company, San Antonio, Tex.

SOUTHWESTERN PUBLIC SERVICE ASSOCIATION. Secretary, E. N. Wills, 403-4 Slaughter Bldg., Dallas, Tex.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

UTAH ASSOCIATION OF ELECTRAGISTS. Secretary, Blaine Gray, Salt Lake City, Utah.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. W. Peterson, Saint Albans, Vt.

WEST VIRGINIA-KENTUCKY ASSOCIATION OF MINE, MECHANICAL AND ELECTRICAL ENGINEERS. Secretary-treasurer, Herbert Smith, 211 Robson-Pritchard Bldg., Huntington, W. Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN STATE ASSOCIATION OF ELECTRAGISTS. Secretary, H. M. Northrup, 23 Erie Street, Milwaukee, Wis.

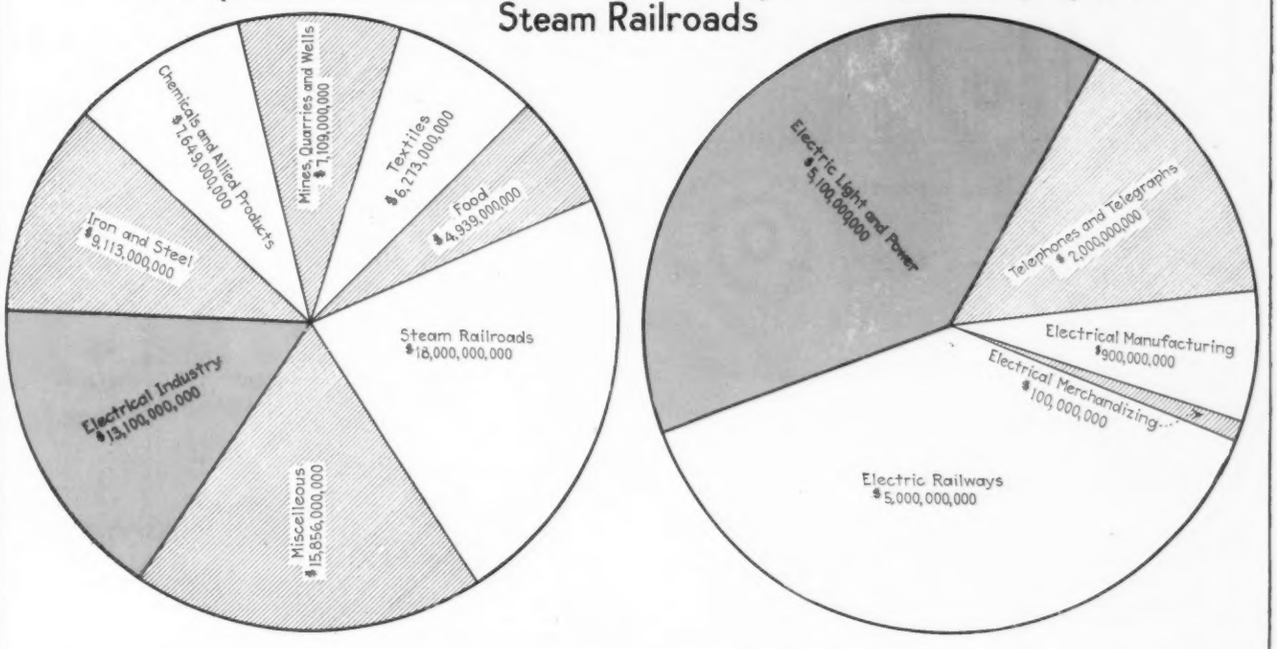
WISCONSIN UTILITIES ASSOCIATION. Executive secretary, John N. Cadby 445 Washington Bldg., Madison, Wis.

WYOMING UTILITIES ASSOCIATION. Secretary, C. Luscombe, Western Light & Power Co., Boulder, Col.

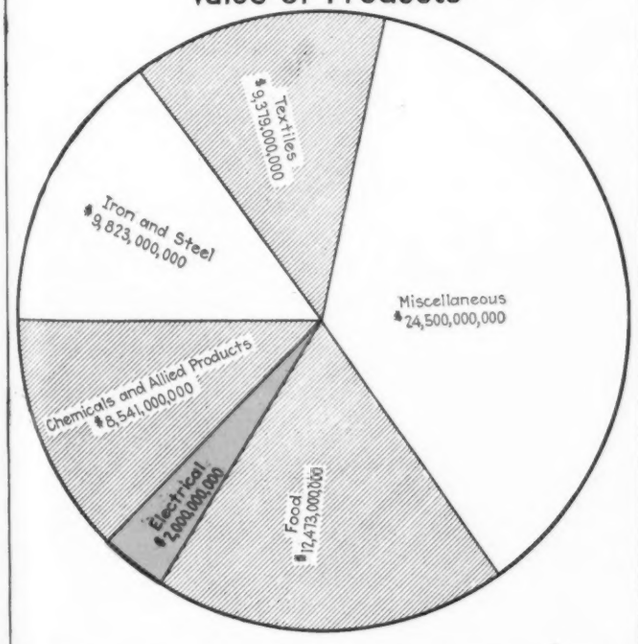
Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

The Capitalization of the Electrical Industry is exceeded only by the Steam Railroads



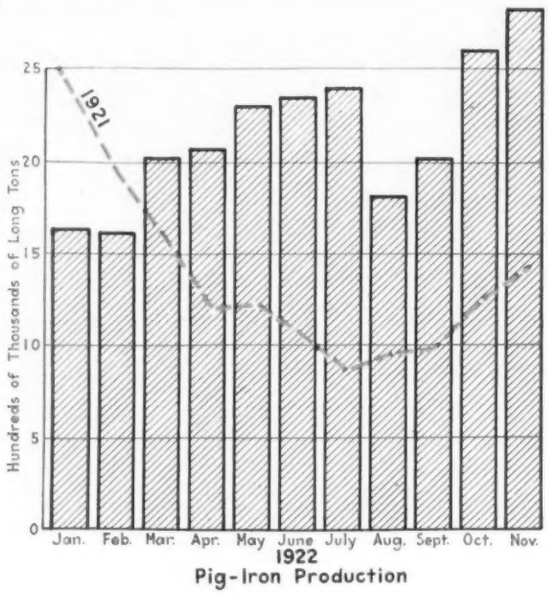
Food Industry easily leads in Value of Products



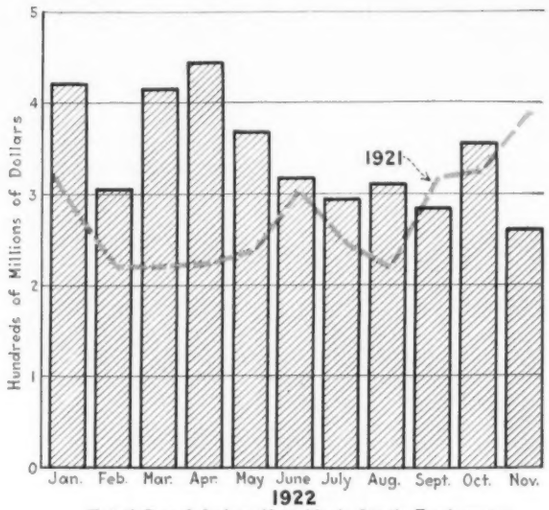
The Place of the Industry

FROM its small beginning in the last quarter of the nineteenth century, the federation of American activities which is known as the electrical industry has become second only to that backbone of American business life, the steam railroad. Not only is this true as regards the amount of money invested in the two industries, but in influence and indispensability this newcomer is today pressing the railroads for premier place.

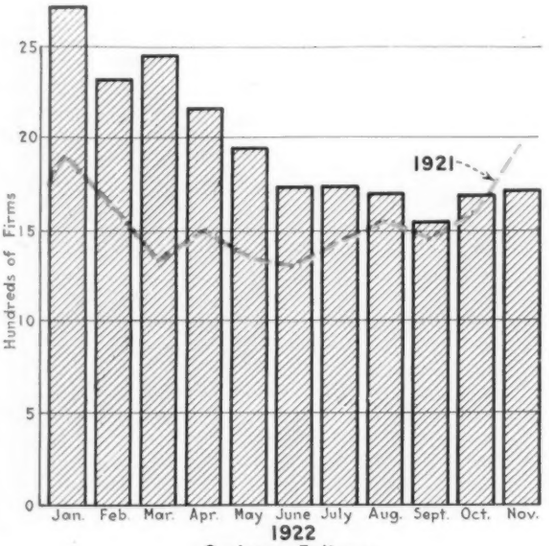
Within the family itself the same contest exists between the electric light and power companies and the electric railways. In this instance, however, it would appear that the electric railways are running a losing race. The end of 1923 should see the electric light and power companies many hundreds of millions ahead in number of dollars invested.



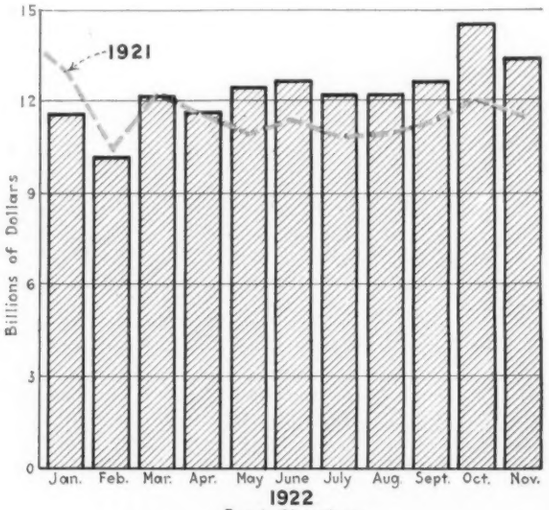
Pig-Iron Production



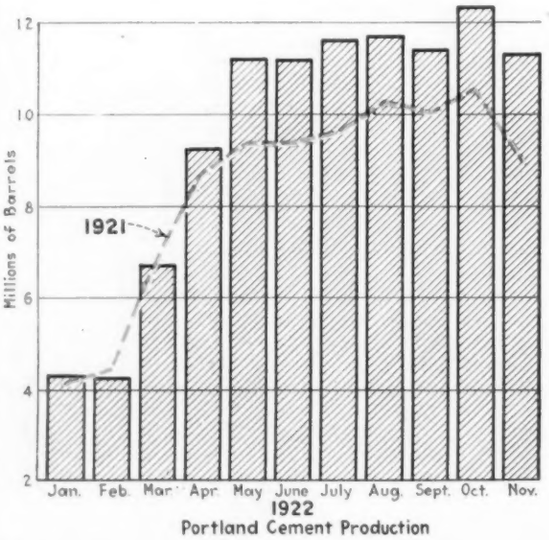
Total Bond Sales, New York Stock Exchange



Business Failures



Bank Clearings
(Outside of New York City)



Portland Cement Production

The Business Horizon Is Clear

AT THIS TIME of the year it is customary for business to pause long enough to take account of the progress made during the twelve months just elapsed, and from this standpoint to make some conjectures as to the coming months of the new year. Most industries can view the progress of the past year with a feeling of satisfaction in spite of the many difficulties which have been experienced. At the close of 1922 there are no serious obstacles in sight which should hinder further advances during the early part of the new year. The unsettled conditions in foreign countries, particularly in Europe, are still depressing our trade, and, to a certain extent have, no doubt, kept the prices of agricultural products below the level of other commodities. However, within the past two months this latter condition has, in a measure, been relieved, and the apparent progress toward a settlement of the German reparations question during the past week is certain to bring added relief to the industry of America and of the world at large.